# HANDBOOK OF DOUGLAS FIR PLYWOOD

PLYWOOD,
THE MODERN MATERIAL

Subflooring, Sheathing, Roof-boarding

Dry-built Walls and Ceilings

Decorative Plywood Panels

How to Finish Douglas Fir Plywood

Special House Constructions

Plywood for Stores and Shops and Industrial Buildings

Grade Use Guide

UNITED STATES PLYWOOD CORPORATION

*Reprinted from American Builder and Building Age, Chicago, New York.*
*American Builder, December 1937.* 

# HANDBOOK OF DOUGLAS FIR PLYWOOD

## The Forests Come Home

**By PAUL DeHUFF**

First Vice President, Building Contractors Association of Southern California

THE frontiers of America, less than a century ago, were plainly and unyieldingly marked by almost impenetrable forests of timber—forests that swallowed up our pioneers—forests that sheltered every known enemy of man's advance. Today these great stands of timber, "peeled" through giant lathes, and glued under terrific pressure, are playing a major part in the advancement of that very civilization which they so long obstructed. Plywood has revolutionized industries. It has created hundreds of new factories—thousands of new products.

The great Hollywood motion pictures studios use more plywood than film. Its versatility and workability together with its high strength and minimum weight make it an ideal material for all effects and yet well able to withstand the constant "punishment" of picture making. The motion-picture drawbridge which "drops with a surly clang" supports a crusading cavalcade in full gallop, yet it is light enough to be carried by a half-dozen men. Sleek "interiors", majestic steamers, massive medieval walls, and a thousand other effects are dependent upon the qualities of plywood.

### Plywood for Many Uses

Such uses of this universal material as racing hulls, cabinets, cupboards, furniture, cases and trailers are everywhere recognized. Except for modernization and repair work in existing buildings, however, the dramatic roles which have been given to plywood in the construction industry are still a matter of news to many. And plywood cannot escape playing an outstanding part in that vast new frontier of construction—the American home under five thousand dollars.

By whatever name—standardization, integration, modulation, simplification—you choose to call the enlightened trend in home construction, plywood will prove to be one of the few present materials which will readily lend itself to almost every element of the structure and finish. Where plastic materials are used structurally, plywood will provide the ideal forms and molds. Where paper, fabric, or pigmented finishes are desired, this material will provide a staunchness against shrinkage, diagonal forces and settlement hardly to be found in any material of equal weight and cost.

If the natural beauty of wood, itself, is wanted, plywood will present an undying and check-proof pattern which only nature can ever paint.

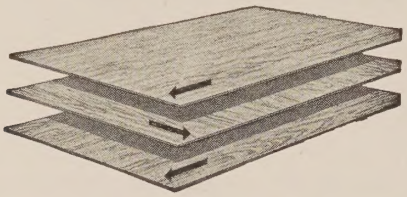
The workability of a material will, in the future, be a major point in considering that material for construction uses. The more nearly finished a material or element is when it reaches the building site, the more will construction costs be reduced. The staggering waste represented in job-site labor is largely consumed in picking over comparatively "raw" material, measuring, squaring, cutting, fitting and the slack which comes between each of these. A very small fraction of the typical job-site man-hour is actually used in "construction." Here, in plywood, is a material which is manufactured in "straight-line" production, and whose thickness, and whose dimensions can be and are controlled within the thousandth part of an inch, and whose edges and surfaces are absolutely square. These latter characteristics not only eliminate the necessity for working the material into true units, but they eliminate the slip-shod, inaccurate work which characterizes the results obtained with the vast majority of job mechanics.

Important changes in construction methods and uses always require adjustments in the economic relationship between men and methods. In the extensive use of such modulated or standardized elements as plywood and other "stock" building elements, the man-hours which were previously used in the wasteful and intermittent job-site employment will come to better economic and social use in steady employment in factories and shops in which precision will replace inaccuracy, productivity will reduce costs, and year-round employment will replace the uncertainties of field work for the craftsman. While labor has, at times, resented the advent of a material which would reduce tool-work at the building, it has always proven that the new market possibilities opened up by such an advent have invariably absorbed more men than were needed for the older method. The increased uses of plywood will more than pay the industry and the public for the readjustments which take place.

Plywood, having solved many an industrialist's and manufacturer's problem is now coming into the field of its first use, to lend its well-grained character to the advancement of that chapter of American construction history which is about to be written, and which will be known in the days to come as the most romantic and the most profitable—the economic refinement of the American Home.

## Plywood, the Modern Material

PLYWOOD is defined by the U. S. Forest Products Laboratory as "a piece of wood made of three or more layers of veneer joined with glue and usually laid with the grain of the adjoining plies at right angles. Almost always an odd number of plies are used to secure balanced construction."



DETAIL showing construction of Douglas fir plywood panels. Each veneer is placed in such a position that the grain of the succeeding veneer is at a 90 degree angle to the previous veneer.

## Manufacture

Selected logs of Douglas fir, one of the two best structural woods in the world, are cut into "blocks," usually about nine feet long. The block is placed in a giant lathe and rotated against a long sharp knife which peels off the wood in a thin continuous ribbon of veneer, of the exact thickness desired, much as wrapping paper is unrolled. The ribbon of veneer is carried on conveyors to the clippers where defects are cut out and the veneer is clipped to desired widths. Next the veneer is sent through automatic driers to remove all but 2 or 3 percent of moisture, and then to the glue spreaders where expert workmen lay up the sheets crosswise in an odd number of plies, usually 3 or 5. The stacks of veneer sheets are placed in hydraulic presses and clamped under pressure of 150 pounds or more per square inch, until the glue has set stronger than the wood itself, transforming the sheets of veneer into strong, rigid panels of Douglas fir plywood. These panels are cut accurately to desired size, machine-sanded to a satin smoothness, and after a final check by Association inspectors are ready for shipment.

## Glues

The adhesives used in manufacturing Douglas fir plywood are the strongest, most highly water-resistant protein glues known to modern science. The base for these remarkable cold glues is chiefly soya bean, blended with casein. Combined with expert workmanship and a skillful technique, such glues produce stock fir plywood that is permanent for all normal interior uses, even when exposed for long periods to high humidity and some moisture.

Standard panels of Douglas fir plywood, even with the high water-resistance of the cold-pressed glues, are not recommended for permanent exterior exposure. True, a special grade of fir plywood is made for concrete forms and re-uses 15 to 20 in number are not uncommon.

Synthetic Resin Glues: To meet the demand for a strictly waterproof glue line, hot-pressed, resin-bonded Douglas fir plywood is now available for such severe exposures as house exteriors, boats, surf boards, signs and billboards. Experience records from Europe, as well as numerous tests, show that synthetic resin glue is as unaffected by water as bakelite or similar materials.

## Physical Properties

The special features which make fir plywood important to the construction industry are:

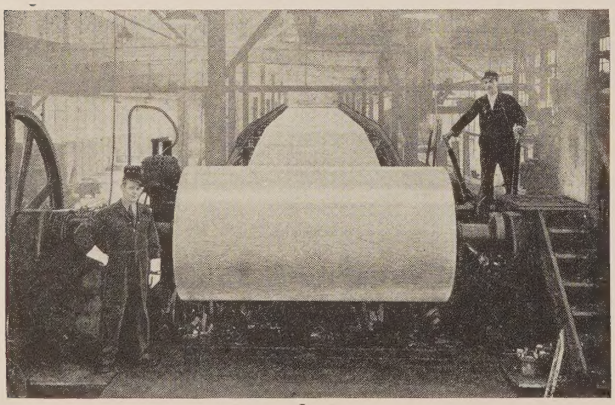
1. Large panel sizes
2. Strength and rigidity both lengthwise and crosswise
3. Practically no shrinkage or expansion
4. Minimum of warping
5. Non-splitting

Large plywood panels meet the demand for a material with a minimum of joints, totally impervious to air, sturdy, yet handled easily by one man. Speedy, economical application is thus assured.

The factors of strength, freedom from splitting, warping and shrinkage are linked with the cross-banding of the thin veneer sheets from which the plywood is formed.

Along the grain, wood possesses a tensile strength and stiffness many times that across the grain. Along the grain, wood has practically no expansion or shrinkage.

Since fir plywood, through its cross-banding, has wood fibres running both along and across the panel, it acquires great strength and stiffness in both directions, as



HUGE Douglas fir log cut to length and ready to be fed to the rotary veneer knife.

PLYWOOD concrete form panels produce smooth concrete surfaces. View shows Seattle factory under construction.

well as immunity from the effects of moisture changes—the longitudinal fibres in one veneer prevent the adjacent, tightly-glued sheets from shrinking or expanding. This also minimizes any warping tendency. Finally, the crossbands prevent splitting. It is possible to smash the edge of a plywood panel with a heavy axe, but it cannot be split.

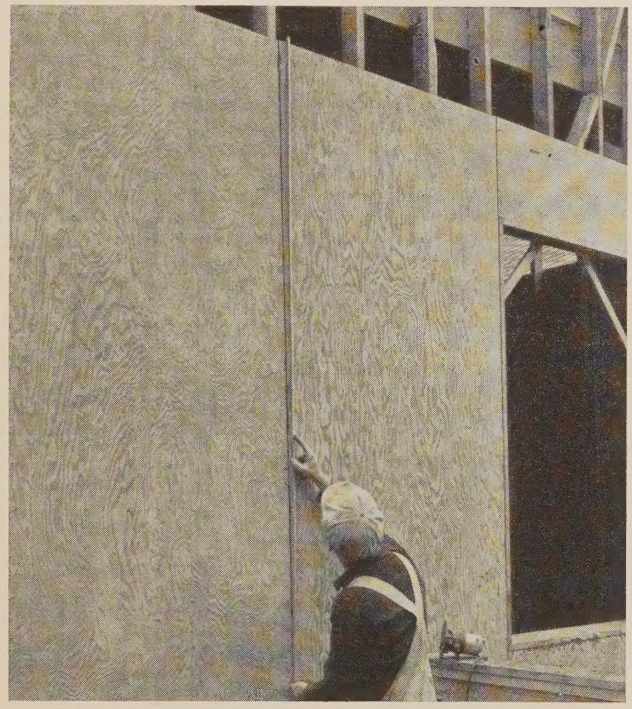
## Advantages of Plywood

Such artificial properties combine with the natural strength, workability, heat resistance and other properties of the Douglas fir wood to form a building material of varied potentiality, one which for many purposes approaches the ideal in both the industrial and the construction fields.

Plywood's suitability to various industrial purposes depends upon the specific requirements for each use.

In auto bodies and trailers, for example, strength, large size, light weight, and workability are important. For railroad car lining, the strength and rigidity of plywood, as well as its tightness against dust, cinders, or grain leakage, are vital. In models and foundry patterns, toughness and workability are prime factors. Scores of examples of industry's capitalization on plywood's unique properties could be listed, but most important of all, probably, is the application of Douglas fir plywood to the Construction Industry. Everyone is familiar with plywood in door panels, and in wall paneling, as well as in kitchen cabinets and built-ins.

The building industry has become familiar with the more recent adaptations of fir plywood, steadily increasing in volume during the past six years, for such structural purposes as subflooring, side-wall sheathing or boxing, and roof sheathing. In the following pages, these and many closely allied uses will be described in accordance with details of best modern practice.



LARGE plywood sheets speed exterior wall construction. Photo shows panel joint in a special system of construction, which is grooved out with electric router, then coated with glue and fitted with special spline. After the glue is set, spline is sanded flush.

## Select Proper Grade

In view of its diversified uses, fir plywood is manufactured in several different grades and types, thus providing for any service, a material that is best suited to the requirements.

Four "appearance" grades are produced, i.e., G2S (good two sides); G1S; So2S (sound two sides) and Wallboard. All of these are sanded smooth to the exact sixteenth inch thickness desired, and are suitable for interior paneling, partitions, and cabinet work. A "GOOD" side or face in a panel is one piece of practically clear Douglas fir veneer. A "SOUND" face may have several neatly made patches, but is suitable for painting, or even a natural finish.

Supplementing the Wallboard grade which has a sound face and is by far the most popular plywood grade, is the Sheathing or Utility grade. Since this is unsanded, it has thicker faces than any of the other grades and consequently is stronger and more rigid. It is this Sheathing grade that is becoming so popular in the 5/16 and ⅜-inch thicknesses for house construction.

For formwork a Concrete Form Panel grade is made with a cold glue, specially high in water-resistance which permits a large number of re-uses, fifteen and more being by no means uncommon.

As already mentioned, hot-pressed resin-bonded fir plywood is available not only for temporary formwork, but also for permanent exposure in boats, store fronts, exteriors of houses, service stations, and other structures. This resin-bonded plywood with its strictly waterproof glue line, supplements the regular stock panel grades with their water-resistant glue-lines, and augments the applications of Douglas fir plywood to cover almost any type of service.

## Construction

The use of plywood in construction may be divided into two classes.

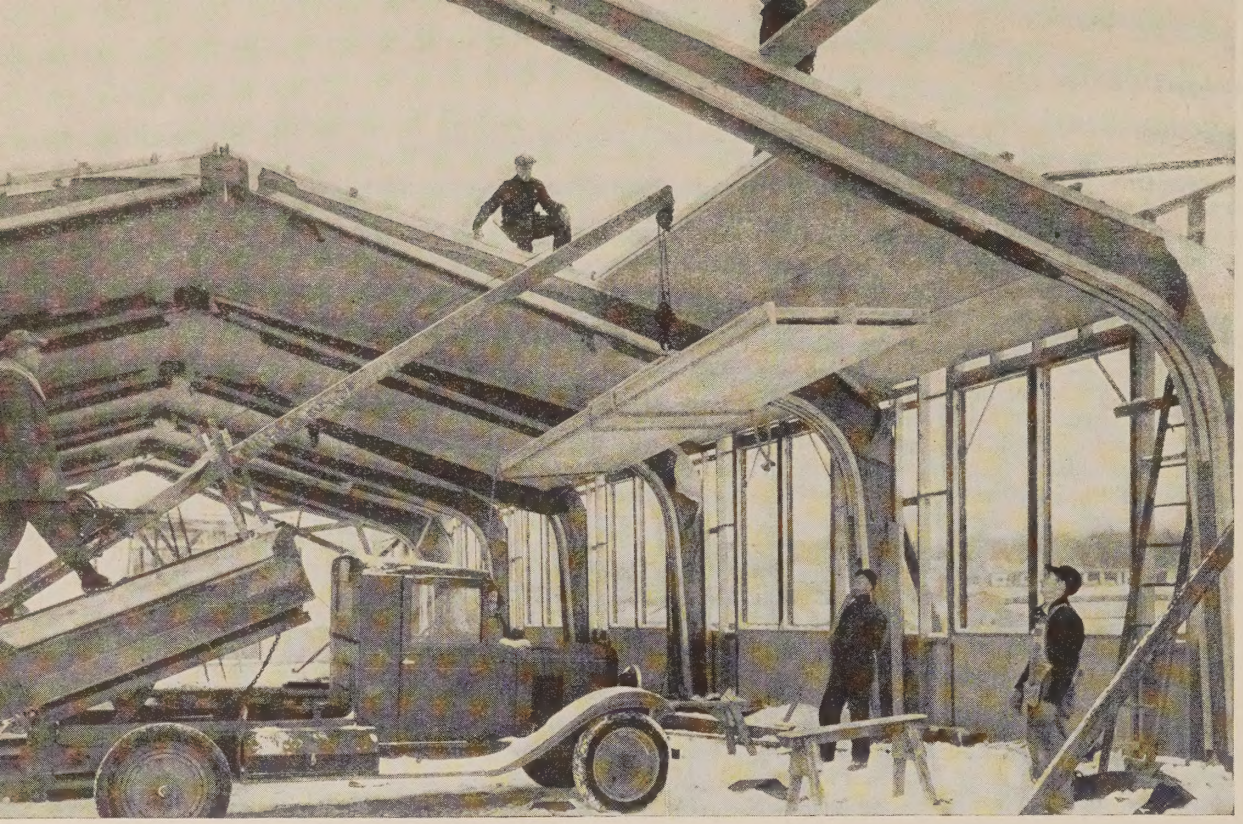
First are the conventional applications for sheathing, subflooring, paneling, formwork, and the like, which represent by far the largest volume and the greatest potentialities.

Second, is the prefabricated field, including both partial and total shop fabrication, or, fabricated units for walls, roofs and floors, and entire rooms.

Prefabrication has been attempted for years with a host of materials and combinations of materials. Plywood, and particularly Douglas fir plywood, because of its economy, strength properties and limitless supply, has seemed to offer the greatest possibilities in this field. Numerous laboratories, research groups, architects, and builders have tried out plywood in prefabrication. The U. S. Forest Products Laboratory, with its prefabricated plywood houses, was one of the pioneers in the shop-built plywood wall unit, floor panel, and roof panel.

Two new plywood houses are now nearing completion under the direction of the Laboratory.

During the past few years the Purdue University Housing Research Project has conducted painstaking investigations on various materials along similar lines, and is now building a plywood prefabricated house. Such experienced technicians as Joseph Weston of Los Angeles and Harry Durbin of Detroit have turned to partial shop fabrication as a means of practical economy. E. A. Horn in Seattle has developed ingenious plywood wall sections which dovetail quickly, simply, and strongly, and which give promise of adaptability. Details of one of his earlier plywood houses appeared in the July 1937 *American Builder*. How far such developments will go, no one



PREFABRICATED roof panel being erected at Forest Products Laboratory, Madison, Wis.

can predict, but the trend is definite and will be followed closely by progressive minds in the construction industry.

In the meantime, the more familiar and conventional methods of using fir plywood must come in for major consideration.

Let us start with the conventional house, after foundation and floor joists have been laid.

## Subflooring

Douglas fir plywood offers an almost ideal material as subflooring. The giant panels, with their laminations furnishing an all-directional strength and distributing stresses from concentrated loads over wide panel areas, provide a smooth, tight platform of surprising and superior rigidity.

For residences, fir plywood subflooring is preferably 5/8-inch "Sheathing" grade. Both tests and experience have proved its adequacy. Tests show that a 5/8-inch plywood panel, laid without nailing over 16 inch joist spacing, will take a uniform load of more than 160 lbs. per square foot, and yet deflect less than 1/20th of an inch. Experience on numerous jobs shows that a 5/8-inch plywood subfloor offers a rigid platform free from any apparent deflection under heavy conventional loads, and a safe working base. A typical experience is that quoted by Geo. E. Todd & Son, General Contractor near Los Angeles, California, on a large residential job.

SUB-FLOOR of 5/8" Douglas fir plywood gives smooth, rigid working platform. Photo shows residence of Earl Hoffman, Los Angeles.

"We were very much pleased with the speed with which we were able to apply the plywood.

"It took us, that is, four carpenters, two hours to lay and nail 2000 board feet as a subfloor—normally it would take six hours for the same number of men.

"Relative savings were effected also on the exterior and roof sheathing.

"There is practically no waste. . . . Furthermore, it makes a very clean floor for marking off and laying out partitions and cabinet work."

Plywood also prevents any dust, dirt, or cold air from working up from the cellar, and helps to keep the house liveable.

Plywood subflooring should be applied with 8d nails, not more than 6 inches apart at ends and 12 inches elsewhere, with the panel running lengthwise across supports in order that the grain of the face plies will be parallel to the span. Plywood applied this way is considerably stiffer than if laid along the joists.

Plywood subflooring is applied economically because the panels are large (4′ x 8′) but at the same time light enough to be handled by one man. Moreover, they provide an unbroken working platform during construction for all trades, reduce the accident hazard from falls, stepping on loose planks and the like, and indirectly but noticeably speed erection.

### Douglas Fir Plywood as Flooring Base

Plywood subflooring is suitable for various types of finish flooring, whether conventional hardwood or softwood strips, woodblocks, or one of the many resilient materials such as linoleum or rubber tile.

Among the plywood advantages listed for such uses are smoothness; freedom from cupping, warping, squeaking and shrinking; and small number of joints. Plywood is used in both new installations and remodeling jobs.

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# Use of Plywood as a Subfloor Under Linoleum

**by Noel L. Dahlander**

*Mr. Dahlander is a widely known New York floor consultant and his firm, The Dahlander Flooring Company, specializes in the installation of linoleums and the resilient type of floor coverings.—Editor.*

DOUGLAS fir plywood has proven to be a very satisfactory material upon which to lay linoleum or other resilient floors. Its advantages are many. First, let us take up the question of covering old, worn, wooden floors: the common, or old, method of covering this type has been heretofore laborious, dirty, and far from really satisfactory. The method previously used has been to sand or refinish in order to obtain a smooth, true surface on which to lay the floor covering.

By the use of plywood a far better underfloor can be obtained without danger of the old wooden floor warping. The satisfactory method for laying is, of course, to take the largest available sheets that the space permits. Then scribe to fit outer walls or around any obstructions. Butt joints as closely as possible; nail tightly at all joints, spacing nails not more than six inches apart and opposite each other on each sheet. Edge nailing should not be over one inch from the joint. The center of each sheet should be face-nailed on six to eight-inch centers, preferably with a coated or corrugated nail. These nails do not pull and work up like ordinary nails.

When the sheets have been laid all joints should be thoroughly filled with a good crack filler, forcing the filler carefully between the joints, preferably with a three-inch putty knife. There is a tendency for mechanics to use a trowel for this purpose. A trowel only places a skin coat on the surface, whereas a putty knife forces the material properly between the joints. If a little care is taken in this operation a lot of trouble will be avoided, and a perfect installation will be the result. When the crack filler has dried, probably the following day, all joints should be carefully hand-sanded, using a block of wood. The block of wood will give the sandpaper the true, flat surface which again finishes the job perfectly.

The economy of using plywood over all worn floors is an issue to be given careful consideration. With the old method of sanding, unless the floor is given a good coat of an expensive sealer, the danger that the wooden floor will warp again is ever present. While the job may be done and passed, quite often months later you will be called back and shown a floor that is nearly as bad as the original old floor, if not as bad.

There is still the danger, even with a sealer, that this may occur. First is the cost of sanding, which is not only an expensive but a dirty job, causing much inconvenience if the house is occupied. Next is the cost of the sealer, plus the cost of labor applying same, and third, it is absolutely necessary to lay a felt lining.

If plywood is used it is unnecessary to use felt. If the plywood is applied properly as before outlined, the surface

**OVER old floors plywood panels may be laid as ideal base for linoleum and other resilient flooring.**

will be smooth and even, and the plywood itself will act as a good cushion. In fact, even lighter gauge linoleum can be used. We are not, however, recommending the lighter grade unless it is actually a question of dollars and cents. The reason for this is very plain. With the lighter gauge materials there is less wearing surface and shorter life, and having laid a good foundation it is better by far to use the best grade of floor covering, as the life of the material is going to be preserved by having a perfect foundation.

Plywood not only makes a good surface for linoleum, but has decided advantages where asphalt tile, rubber, or similar materials are desired. Owing to the reduction in the number of joints, the surface presented by plywood makes an ideal underflooring.

So much for the old floor.

### Use for New Construction Results in Solid Jobs at Cost Savings

Where new construction is involved the use of heavier plywood which takes the place of both the underfloor and the finished floor is, of course, a decided advantage. The underfloor will be smoother, have fewer joints, and a more solid construction. There will be less danger of warping and the floor will be cheaper to lay.

The saving in installation cost alone, in comparison with double flooring, which in all good construction should be expected, will quite often offset the cost of the heavier plywood.

## Sheathing with Douglas Fir Plywood

THE ideal sheathing material is strong and rigid, air-tight, rugged without excessive weight, split-proof, easily nailed and worked, yet quickly and economically applied.

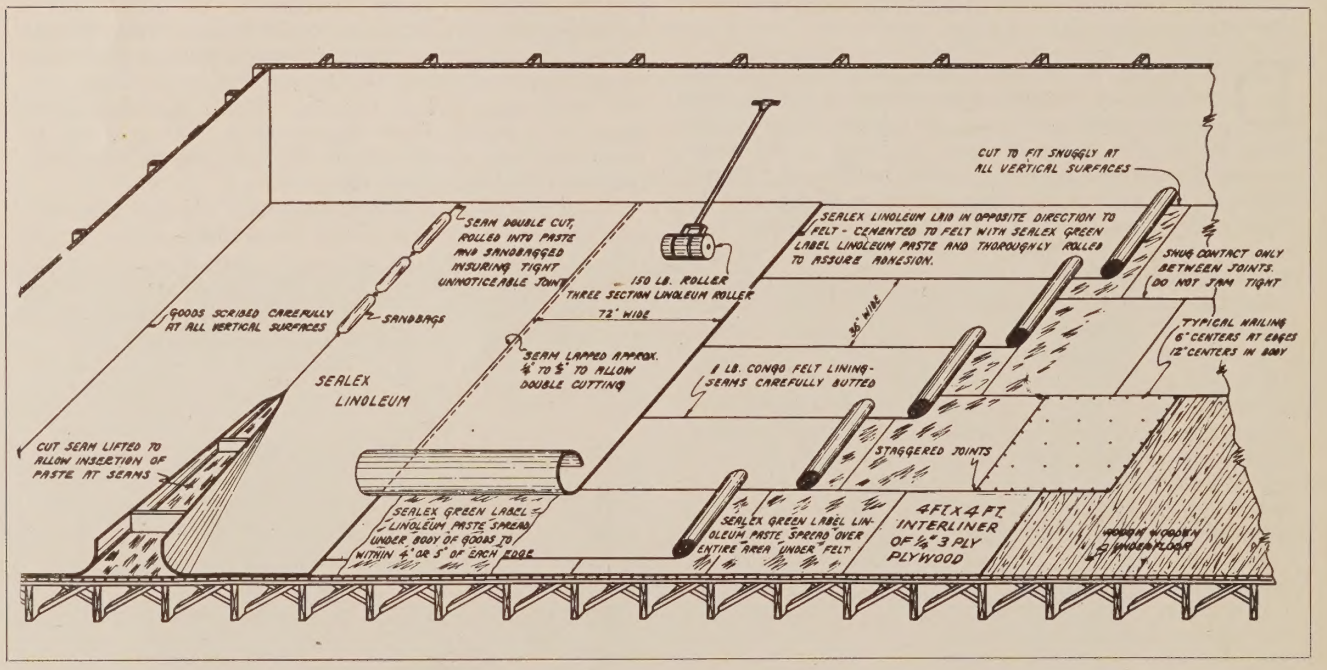
Fir plywood, 5/16-inch thick, in the "Sheathing" grade fulfills all these conditions. Tests at the U. S. Forest Products Laboratory, foremost authority of its kind, have demonstrated that ¼-inch, and hence to a still greater degree 5/16-inch, fir plywood sheathing makes a frame wall 40 percent more rigid than conventional diagonal sheathing or let-in braces; nearly four (4) times as rigid as cut-in bracing; and nearly six (6) times as rigid as horizontal sheathing.

Further series of tests at Portland, Oregon, and Detroit, Michigan, as well as hundreds of job experiences, have substantiated the government laboratory figures.

The large conventional panels, 4′ wide by 8′ long, have few joints and if laid vertically even these few will be backed up by a solid stud or plate. Plywood sheathing, therefore, is practically air-tight and hence requires no building paper to help exclude the chill blasts of winter.

Plywood is made of solid wood layers and hence is not porous enough to be classed as an insulating board. Nevertheless, although impervious to winds, plywood does possess thermal insulating properties and has a conductivity of 0.78, the same as Douglas fir lumber.

A wall sheathed with fir plywood, then furred and covered with wood siding and paneled on interior with ¼-inch plywood, has an even better insulating value than




### SPECIFICATIONS FOR INSTALLATION OF PLYWOOD AS AN UNDERLAY FOR SEALEX LINOLEUM OVER UNEVEN WOODEN UNDERFLOORS

Where a wooden underfloor is uneven, splintered or rough, due to wear, it shall be levelled out through the use of ¼" Douglas fir plywood of the wallboard grade.

The sheets shall be not larger than 4'x4' and they shall be so laid that vertical joints will be staggered. Each sheet, as it is laid over the uneven wooden floor, shall be nailed 6" on centers at all four edges and 12" on centers through the body. Succeeding sheets shall have snug contact only at the joints and shall not be driven tight. At all vertical surfaces the Plywood shall be cut to fit neatly, leaving not more than ⅛" opening at any point.

After the plywood has thus been laid over the entire area, 1 lb. dry lining felt shall be installed over the entire area, using Sealex Green Label Paste to secure it to the plywood. Over this the linoleum as specified shall be installed, using Green Label Paste to cement it to the felt. The sheets of the linoleum, as they are laid, shall be run in the opposite direction to the felt.

The felt and the linoleum shall be installed in accordance with the manufacturer's specifications.

5/16" Douglas fir plywood sheathing for suburban residence in Winnetka, Ill.—One-man panels speed construction.

PHOTO below shows plywood roof sheathing as base for wood shingles, double coursed for shadow lines.

"Standard Frame" construction which has stood since early Colonial days for a comfortable and satisfactory type.

To the builder and contractor, the other advantages, such as workability, split-proofness, and ruggedness under severe handling, are less important than that of economy. The 5/16-inch utility or Sheathing grade of fir plywood compares favorably in price with conventional materials which are necessarily thicker and heavier.

Freight and other transportation costs naturally favor a thinner, lighter material.

Plywood's chief advantage, however, lies in its low cost of handling and applying. The stock 4′ x 8′ panels, 5/16-inch thick weigh only about 30 pounds—a convenient one-man size—and with 32 square feet at a time going into place, it is easy to see why builders claim tremendous savings. In addition, plywood requires fewer and smaller nails. Location of openings, of course, affect the amount of cutting but savings of 40 to 50 per cent seem conservative for plywood sheathing; and some builders claim they can cut their labor to about one-third.

## Application

5/16-inch plywood sheathing is applied with 6d nails, not more than 6 inches on centers at edges and 12 inches on intermediate studs. Such nailing develops a high percentage of the panel's strength and removes the necessity for diagonal bracing when fir plywood sheathing is used. In fact, at the Fifteenth Annual Pacific Coast Building Officials Conference, held October, 1937, at Los Angeles, plywood sheathing 5/16-inch thick was given approval (tentative for one year, as required under Conference by-laws) and angle bracing was eliminated.

Builders apply the panels both vertically and horizontally on the walls, although the latter is slightly better from a structural standpoint.

Plywood sheathing is suitable as a base for conventional exteriors of either siding or shingles, or of masonry veneer. Wood siding is nailed through the plywood to the studding. Some prefer to use vertical furring strips over the plywood at each stud, thus creating an air space and extra insulation between siding and sheathing.

As a base for wood shingles, 5/16-inch plywood has been tested and approved by such an eminent authority

as Prof. Bror Grondal, University of Washington, and special consultant for the Red Cedar Shingle Bureau.

In the tests, it took a minimum of 85 lbs. to pull an 8 inch shingle, one of a panel, from 5/16" plywood. Tests on other conventional bases showed the same minimum and only slightly higher averages.

Eighty-five pounds on an 8" shingle, with 5" to weather is equivalent to a wind load of nearly 300 lbs. per sq. ft., enough force to blow any building in the world off its foundation.

The reason for this somewhat surprising characteristic of fir plywood is that the ultimate failure is due to the nail heads pulling through the shingles before the nails can be pulled from the 5/16" plywood.

## Roof Sheathing

Stiffness or deflection resistance is a factor in roof sheathing, the amount needed depending upon snow loads, and other live loads and rafter spacing.

The proper thickness of fir plywood sheathing to use may vary from 5/16 inch for rafters 18" apart, and roof loads not exceeding 20 lbs. per sq. ft., to ⅜" sheathing for 20" spacing and 30 pound loading, and up to ⅝" sheathing for 30 inch spacing and 30 pound loading. Details for computing proper thicknesses are given in the guide at the rear of this Handbook.

## Paneling

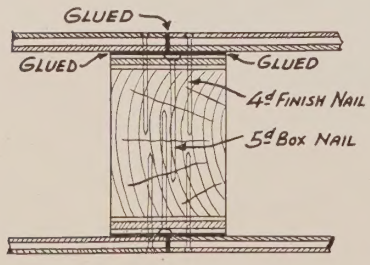
Walls of Douglas fir plywood are suitable to almost any type of home—from the simple cottage to the costly manor. Its adaptation to structures other than homes is only a matter of selection from the wide range of decorative possibilities. Any room to be sealed, whether in a home, store, office, or school, may be tastefully finished with fir plywood. Its flexibility means limitless opportunities for the development of any decorative finish.

While fir plywood walls obviously are suitable as a base for wallpaper and other covering, stained or painted decorative treatments have contributed most to plywood's popularity.

Because of the simplicity of its installation and fundamental low cost, fir plywood is suited to the production of economical walls—especially for modern interiors featuring large unbroken areas, horizontal mouldings, curved wall surfaces, or vertical paneling effects. For "period" interiors the fact that plywood is wood—the basic material of original "period" treatments—requires its use in order to provide authority for the furnishings to follow.

## Flush Joints With Plywood

As a further contribution to the value of dry wall construction, the technique or system of making invisible, crack-proof flush joints with furstix, or glue strips, as they are called sometimes, makes possible unlimited areas of walls and ceilings unbroken by mouldings or joint details.




DETAIL of flush joint between plywood panels reinforced with glued-on strip at the back.

This system is simply an adaptation of the plywood principle of gluing wood at right angles. Strips of plywood 2½ x ¼ inch which have been cut across the grain, are nailed to all studding, rafters and headers. Next, the strips are coated with a commercial casein glue and the plywood panels lightly nailed to the plywood strips so as to provide pressure until the glue sets. The panel edges are drawn up tightly with as small a crack as possible. This small crack is filled with plastic wood or Swedish putty and then the wall is ready for decoration.

## Paneled Walls and Ceilings No Longer a Luxury

Fir plywood, aside from its decorative character, is surprisingly easy to work into interesting and authoritative panel treatments. The architect and owner will be concerned particularly with the effect to be achieved, and these effects are practically numberless, limited only by the mouldings applied in combination with the stained, painted, or covered decoration. The contractor or carpenter is more concerned with the practical application and efficient method of producing permanent, satisfactory work with a minimum of labor.

## Joints

In the drawing there appears representative details for cornices, bases, and joint treatments. Joint E is the same as described above under the name of furstix and is an excellent joint to use even though it is to be covered with a moulding strip. At some future date the owner may prefer an invisible flush joint without moulded panels for all-over stain, paint or wallpaper, in which case only the mouldings need to be removed and the nail holes filled. Joint D is the simplest and most economical treatment. The frank recognition of the joint line may be capitalized upon to designate desired panel arrangement. The plywood panel edges are simply chamferred by a hand or power plane. The slight cracks in the V joints which may result from frame movement are concealed in the shadow-line produced in the V. False V joints may be worked elsewhere in the panels to accomplish completely any desired panel arrangement. Such false joints may be worked with sharp hand tools or power routers. Joint C may be varied, using any of the narrow mouldings such as screen moulds or any specially milled strip. Care, however, should be exercised so that the width of the inserted strip does not require too wide a nailing base and prevent secure nailing of the plywood panels.

Modern treatments may be accomplished successfully and economically by the use of metal mouldings and garnishes, the use of which should follow manufacturers' directions. Metal decoration contrasting with plywood only accentuates the inherent charm of the natural wood and the experienced craftsman may accomplish striking effects.

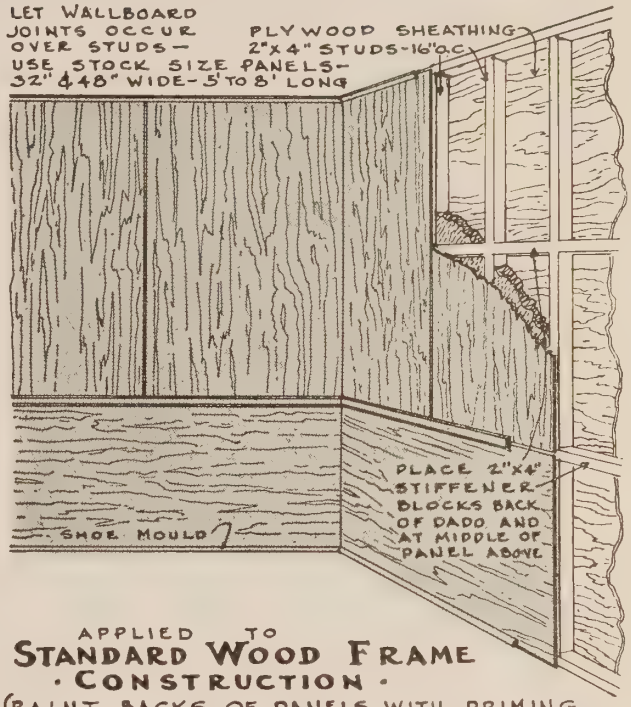
## Cost of Plywood Finish

As labor costs vary in different communities and retail material prices vary according to freight rates and other factors, it is difficult to estimate plywood paneling costs accurately. However, as a matter of comparison with other materials, plywood walls are fundamentally low in cost. An example from a typical market may serve as a basis for rough estimating: If lath and plaster is figured at $1.00 per yard, a room 14′ x 20′ with 8′ 6" ceiling (contains 578 sq. ft. wall area) would cost $64.10 for plaster and is ready for decoration *after*

# Plywood Fits Into Any Type of New Construction---


APPLIED TO
**·STANDARD MASONRY· ·CONSTRUCTION·**

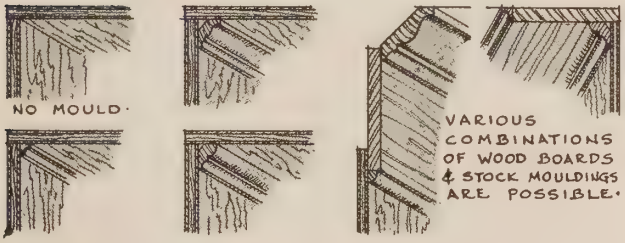
ARRANGE PANELS TO AVOID UNNECESSARY CUTTING AROUND WINDOWS & DOORS




APPLIED TO
**STANDARD WOOD FRAME ·CONSTRUCTION·**

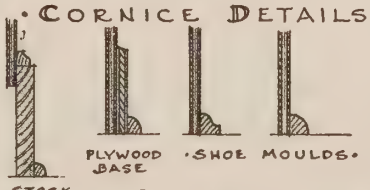
(PAINT BACKS OF PANELS WITH PRIMING COAT OF LEAD & OIL BEFORE PLACING)

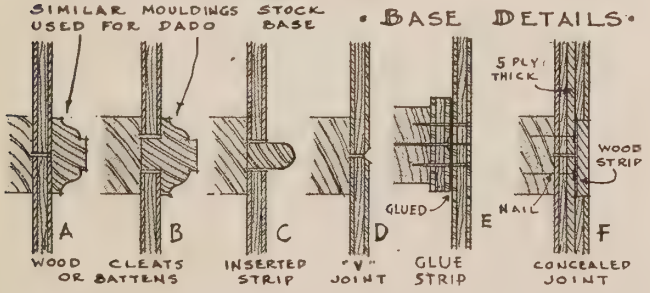
# ---Gives New Beauty to Old Plaster Walls



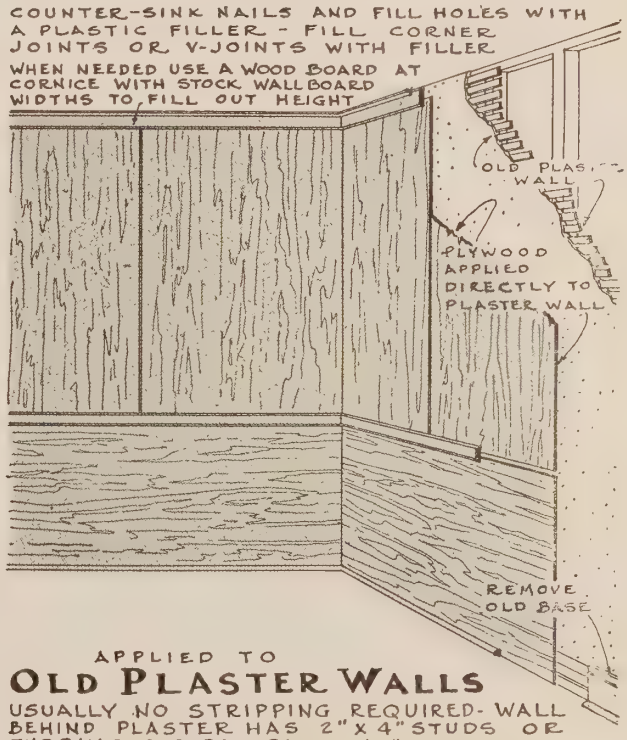

STOCK METAL MOULDING

TO EMPHASIZE SMALL MOULDINGS AND GROOVES— FINISH IN A TONE OR COLOR CONTRASTING WITH THAT OF THE WALL




**VARIOUS JOINT TREATMENTS·**

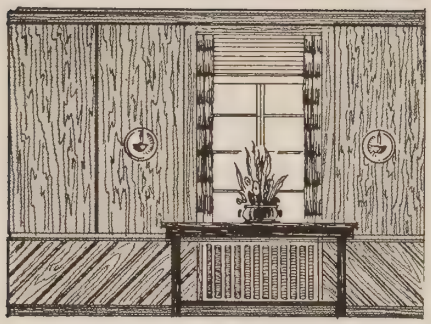



APPLIED TO
**OLD PLASTER WALLS**

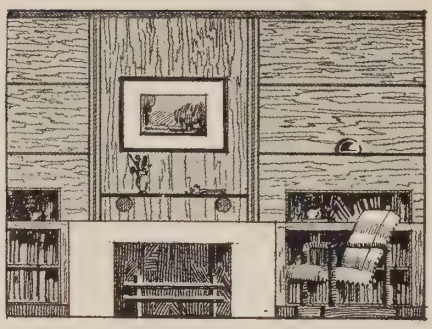
USUALLY NO STRIPPING REQUIRED- WALL BEHIND PLASTER HAS 2" X 4" STUDS OR FURRING STRIPS SPACED 16" O.C.

INTERIOR WALL DESIGNS USING PLYWOOD WALLBOARD WILL BE FOUND ON NEXT PAGE

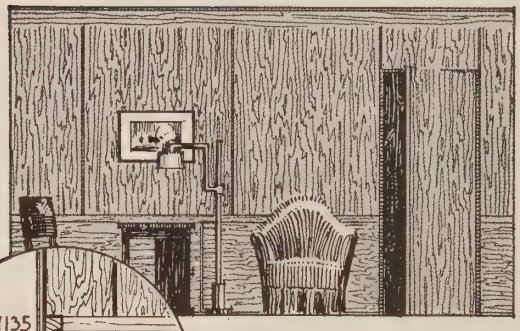
DETAILS of Douglas fir plywood use for wall linings, showing dry wall technique, with various methods of forming the joint between panels.



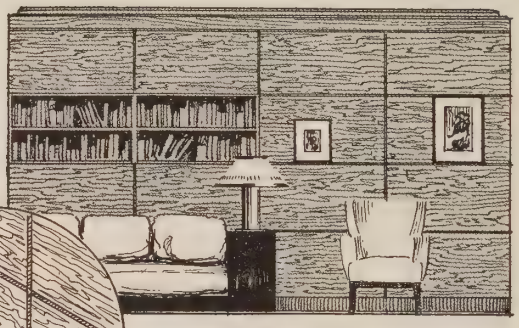
*Vertical Plywood sheets with diagonal wainscot*



*Mixed horizontal and vertical sheets of Plywood*

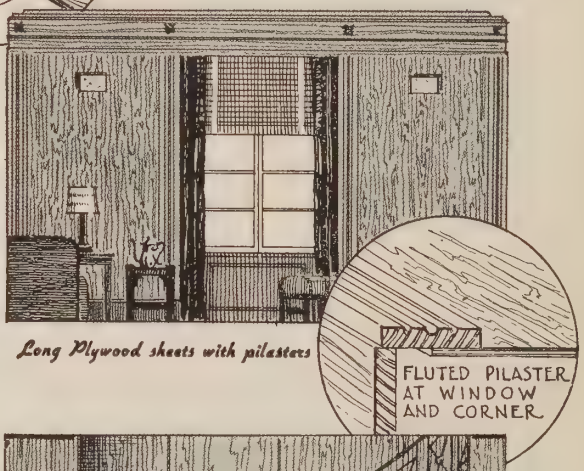



*Vertical Plywood panels with horizontal wainscot*

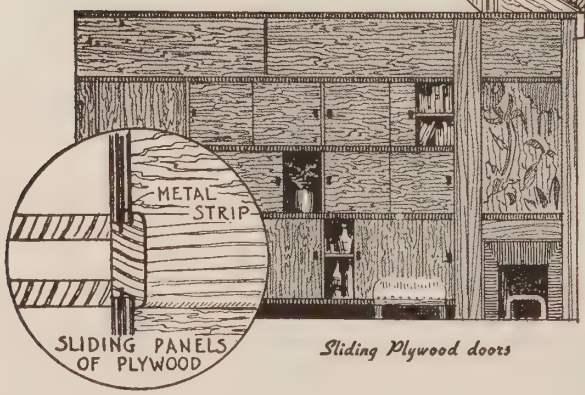



*Horizontal Plywood in small sheets with "V" grooved design*

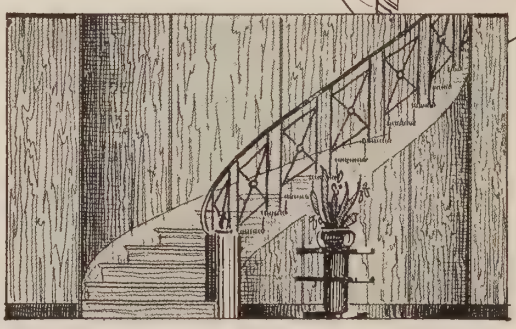

*Plywood sheets used as large flat panels---with rails and moulding*




*Long Plywood sheets with pilasters*




*Sliding Plywood doors*



*Vertical Plywood on curved walls*

EIGHT attractive decorative schemes for paneled interiors constructed of Douglas fir plywood. Note inserted details to larger size indicating good construction practice. Plywood is a versatile material for uses of this kind, and numerous attractive surfaces are produced to give beautiful and harmonious effects.

*drying.* The same room may be covered with plywood retailing at .05c per foot, installation cost .04c per foot, for $52.02, and is *ready immediately* for decoration. Decoration costs are comparable with both types.

## Correct Application of Plywood Ceilings

Ceilings provide an opportunity for interesting and distinctive treatment with panels of Douglas fir plywood. Ceilings of permanent safety may be constructed as the crowning glory of rooms, with the stable, sag-proof, crack-proof, and economical Wallboard grade.

Fir plywood is a high-quality building material and, therefore, should receive the same considerate treatment accorded materials of greater cost. The panels are delivered on the job straight and true with a moisture content equal to the moisture content normally found in interiors. It should be piled flat in a dry place with edges even and protected from weather and abrasion.

In doing a job the first step is to lay out the panel scheme. If the ceiling is to be done with moulding or beam treatment proper nailing bases must be provided. The variety of panel arrangement is quite wide and will be determined largely by the decorative effect desired. A primary point to be borne in mind is the fact that narrow rooms may be made to appear wider and, vice-versa, with arrangement of panels.

Nailing surface, whether over old plaster, or direct to joists and headers, must be level to provide flat backing.

Headers or nailing pieces must be inserted between joists on new work so that the panels may be nailed all around—both sides and ends. Over old plaster if furring strips are used, cross strips should be provided for edge nailing. Normally, however, plywood is used over old plaster without any furring. A solid and level foundation for panel edges is paramount. Of course, furring strips over old plaster will be nailed at right angles to the joists. Loose plaster should be removed but it is not necessary to break away solid portions, as the furring strips may be shimmed out with shingles or wedges as shown on page 11.

Correct nailing is important. It is common practice to start the first panel in the middle of the ceiling and work both ways to assure symmetry. 4d finish nails are used and spaced about 8 inches apart on the panel edges and face nailing is necessary on very wide and long panels, 24 inch spacings for face nailings being adequate for ordinary conditions. For unusual humidity or temperature conditions it is advisable to back-prime the larger panels, and if this is done the faces should be sealed shortly thereafter. Face nails and any exposed edge nails should be sunk with nail-set and holes filled with plastic wood or suitable crack-filler.

Moulding choice and arrangement offer wide variety.

Beams may be covered with the plywood and false beams constructed to balance, or steel beams and columns can be covered with fir plywood to match the fir plywood ceiling panels and sidewalls.

# Finishing of Douglas Fir Plywood

### For Cabinet Work and Dry Wall Construction

THE advantages of Douglas fir plywood—its structural strength, beauty of figured grain, the wide variety of thicknesses and sizes, as well as its relatively low cost—have made it a product of great general utility in all building construction, especially for cabinet and millwork and for walls and partitions.

There is a keen desire on the part of building contractors and all manufacturers of building equipment to avail themselves of these fir plywood qualities, and, consequently, every effort is being made to extend its use into fields previously filled by other woods, including hardwoods. Now, practically all wooden products—no matter how used—need a decorative finish or protective coating. This finishing of virtually every species of wood is a problem unto itself, and fir plywood is no exception to this rule. In fact, fir, because of the character of its growth has presented some unique problems. The very beauty of figured grain which has been one of the contributing factors in extending the merits of fir plywood has, itself, presented some finishing problems. This highly figured wood naturally has a great variety of hard and soft grain, and when certain stains and finishes are applied the grain is accentuated or raised.

There are two general classifications into which a discussion of finishing fir plywood falls:

1) Where the plywood is to be used with the grain showing, as for instance with stains, clear finishes, etc., as in all types of cabinet work, paneling, wainscoting, furniture, many types of built-ins, doors, etc.; and

2) As in dry wall construction where the plywood is decorated either with these same finishing materials, or where a wall simulating the ordinary plaster or painted wall is desired, in which case the plywood surface is completely covered.

## For Cabinet Work

Many of the liquids, thinners, and solvents used in ordinary paints, lacquers, and stains have the effect on the soft grain of this as other woods, of raising or accentuating the grain. Alcohol, acetone, and some lacquer thinners are especially noted for this. In the case of paints, this requires a considerable number of coats to be applied (with hand sanding between coats) in order to produce a smooth high quality finish. The pigment in the paint has the tendency of piling up on the springwood, i.e., the softer light colored grain. With stains, there is presented the finishing problem of having these materials strike deeply into the soft grain and coloring it darker or more intensely than the hard grain. With some light colored stains this is not undesirable, but where dark colored water, oil, and spirit stains are used it becomes very difficult to obtain a uniformly attractive color and finish.

Various types of sealers and primers have been used to equalize the surface before applying undercoats and finish coats. However, they have their limitations. A considerable advance has been made by the discovery that synthetic resins in special vehicles could be used to impregnate the surface of the fir plywood and alter the surface conditions so that finishing becomes much easier.

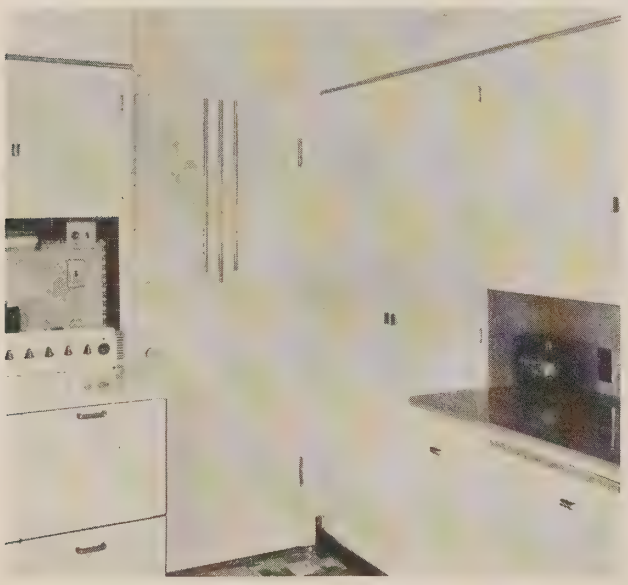
Such a treatment is being applied at the factory by the fir plywood manufacturers and is called "Reziting." It is applied immediately after sanding and prevents the grain from raising due to moisture. Because of its light color it does not materially affect the appearance of the plywood so that all finishes, paints, and stains may be applied without grain raising and without the usual contrasts customary in untreated fir. This treatment, by preventing moisture absorption, also reduces the tendency of the wood to check.

This same type of priming material is generally available throughout the United States for use by the painter or in the finishing plant and is being used by a great number of millwork and cabinet shops as a treatment for fir prior to applying stains, paints, enamels, lacquers, etc. In many instances it is applied to the fir plywood with a saturated rag which method is not only quick but economical and effective. Prior to applying a primer, it is necessary to sand the surface of the plywood using sharp sandpaper which will cut evenly through the hard as well as soft grain. Too fine a sandpaper only works on the soft grain and often produces a wavy appearance when the plywood is painted. It dries quickly, and before applying stains or paints it is customary to touch up the surface lightly with fine sandpaper—then any of the regular finishes can be applied, including water, oil, and spirit stains.

In staining, the effect that is obtained is very similar to that on hardwoods, the only requirement being that the stains must be allowed to stand longer than when applied over an untreated wood surface. When oil stains are used, the operation is more that of glazing, and the stains in general must be heavier bodied than when used over untreated or raw wood. The result is so unusual to fir that in many places stained fir panels can be used where only hardwoods were previously considered suitable. This is particularly true on cabinets, doors, and wall panels. This treatment, acting as a sealer and primer, usully saves a coat of paint and, in general, the results are superior to those obtained over other softwoods.

## Decoration of Dry Wall Construction

The development of dry wall construction which has opened up a tremendous new field for the use of large fir plywood panels has proposed the new problem for finishing. Heretofore when plaster was used, the finishing of all woodwork, including fir panels used in built-in fixtures, cabinets, etc., was a serious problem because of the great amount of moisture present in the house. With this new type of dry wall construction this difficulty is eliminated. These large fir plywood panels are nailed or glued to the studding (in many cases being prefabricated in the shop) and call for many different types of joint treatment, i.e., between panels. This has been solved in various ways with the use of battens, mouldings, etc.



FLUSH doors of Douglas fir plywood painted with semi-gloss paint give a note of cleanliness and efficiency to this kitchen.

In general, however, the desire to obtain a one-piece wall at a low cost which will have all the appearance of a plastered wall, at the same time meeting the requirements of the prospective owner or architect for decorative effect, places upon the contractor new responsibilties.

Where a one-piece wall has been obtained by gluing the panels or wall sections in place, the use of Swedish putty or special joint fillers is required to first even up the surface at the joint. Experience has shown, however, that while skilled mechanics can, if given sufficient time, produce a flawless wall, the general result is that there are certain differences in the plane of the surface and that when the joints are touched up and the wall painted with paint or enamel these slight imperfections are accentuated, particularly when the light falls upon the wall from a certain angle. In order to overcome this, stippling and the use of plastic paints has been used.

When plastic paints are used, it is, of course, necessary to prime the wood surface first, unless the plywood has been factory primed, otherwise the application of a water product to the wall will raise the grain and, also, unless joint fillers are primed, the joints might also be affected.

A new material which is synthetic resin bound and which comes in paste form and is thinned with turpentine or paint thinner, is being offered for the decorative treatment of such walls. It does not produce an absolutely smooth finish. At the same time it is not rough, having just enough relief similar to a wall plastered with fine sand finish plaster. This coating has sufficient elasticity to prevent checking due to extremes in temperature. This is a one-coat material, is applied with a brush, and can be put on over the factory treated "Rezited" plywood quickly, as it dries overnight, and enables the painter to decorate the walls with whatever materials he wishes to use; either oil or casein paint—even wallpaper. This treatment is quicker and less expensive than canvasing or other types of treatment; also it has the advantage of the appearance of a plastered wall, and, most important, it supplies a coating of sufficient thickness and character so that the finished wall is conventional and attractive in appearance and utility in every respect.

* * *

## Storage

THE matter of properly warehousing Douglas fir plywood in comparatively small quantities deserves consideration.

Principal requisites of proper panel storage are that panels should be kept inside under cover; they should be piled flat to avoid inducing a permanent warp, (panels should not be stored on edge): they should be piled evenly, one panel directly above the other to prevent damage to projecting edges from mechanical injury or fading from light; each pile should be covered with canvas, paper, or a "cover panel" to keep the top panel free from dust and in good condition.

The same general rules for proper storage apply after delivery to the job as well. The facilities for proper handling at this point are usually very poor, but provision should be made to pile the panels flat and to protect them from rain or strong sunshine.

# Hanging Wallpaper Over Plywood

**By Burr Gregory**

Burr Gregory Wallpaper & Paint Company

THE wide increase of the use of wallpaper brings forcibly to the attention of the wallpaper man the need for more careful planning on the part of builders to provide a satisfactory surface for paper.

A base for wallpaper which has rapidly gained favor in recent years is Douglas fir plywood. This is due to the fact that it presents a smooth surface with a minimum of joints and because experience has shown that it does not, like many other boards, expand and contract so that the paper cracks over the joints. This quality of plywood is of increasing importance because of the modern decorating trend towards smooth walls unbroken by battens or panel strips.

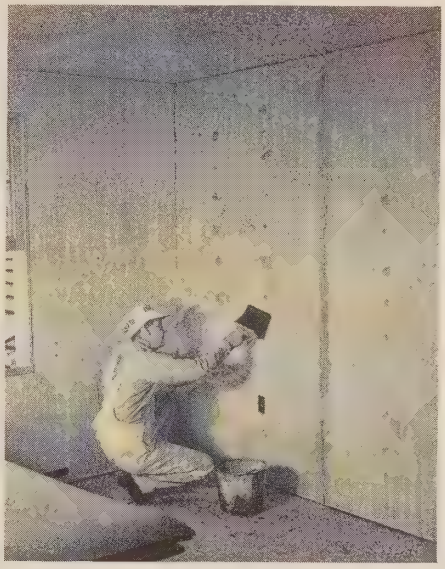
I have been recommending fir plywood for use under wallpaper for some time and have had an opportunity to check numerous finished jobs, and I have yet to find one that has cracked at the joints.

While it is possible to apply paper directly to the plywood a more satisfactory job is obtained by first applying a lightweight felt paper. We usually recommend three-quarter pound felt. The desirability of felt is especially noteworthy when hanging plain papers; otherwise, irregularities of the surface may show through.

This felt is inexpensive and can be applied with ordinary wallpaper paste. Of course, the felt should be butted at the joints so that the surface will be entirely smooth. It is advisable to let the felt ceiling strips run down about one inch on the sidewall. Then, when the felt is applied to the sidewall it should extend to the ceiling, lapping over the one inch that was allowed to drop from the ceiling joint, and since there is always either a moulding or band border at this point this lap will be entirely covered. The felt paper has an added advantage of acting as an efficient sound deadener and insulator against thermal conductivity.

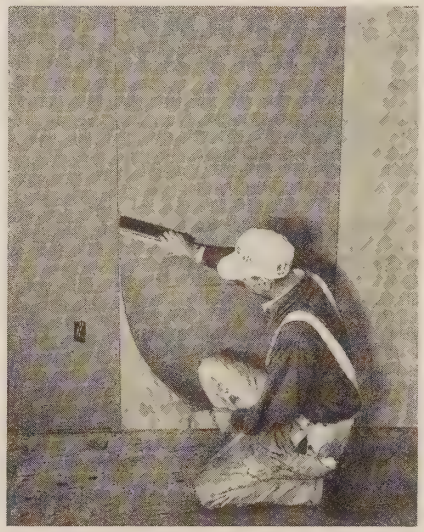
A situation which is sometimes encountered is one in which paper is wanted in a room where the surfaces are plastered and the plaster is cracked or falling off. Here plywood offers the quickest and best solution. The plywood is put on the plastered area, thus preventing further falling away of the plaster and providing the necessary smooth surface for the wallpaper.

We find that the advent of plywood has enabled customers to use wallpaper in numerous houses which otherwise, of necessity, would have been stained or painted. Since modern wallpaper gives such a splendid opportunity to decorate each room in keeping with its use, fir plywood is highly regarded by wallpaper men and their customers.

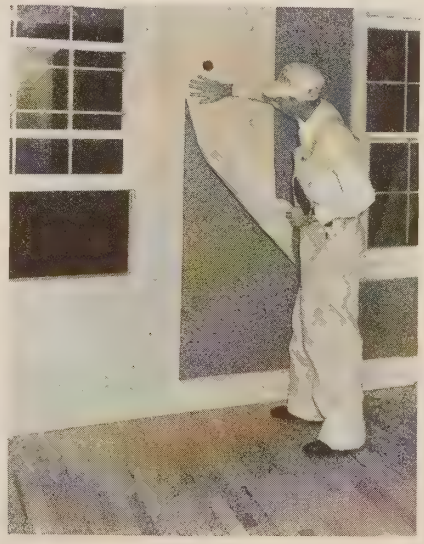


SIZING the plywood with wallpaper paste before hanging the felt assures better adhesion. Joints and nail holes are filled with crack filler and smoothed with a sandpaper block.

THE straight-edge felt is tightly butt-jointed, thereby providing an absolutely smooth surface for the paper.



UNIFORM adhesion of the felt to the plywood is assured by going over it carefully with the smoothing brush.



EXPERIENCED paper hangers prefer felt and Douglas fir plywood as a crackproof base for wallpaper.

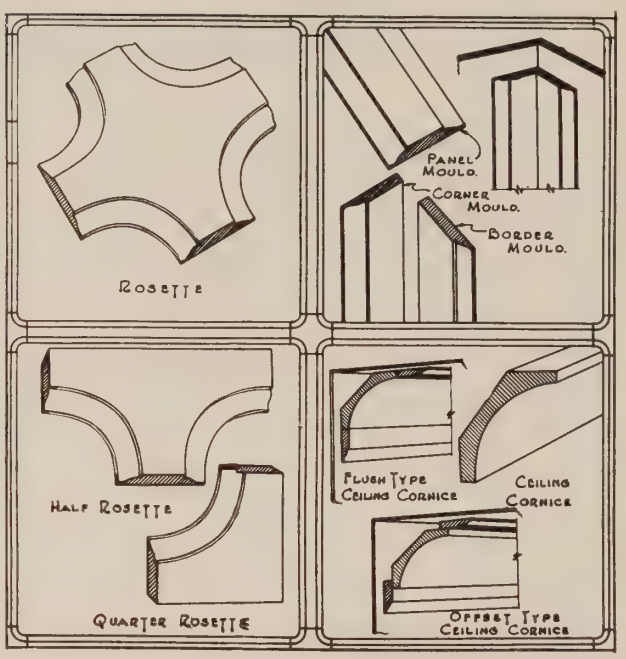
## Special Face Textures and Decorative Systems

DISTINGUISHED textures and groovings manufactured into the face veneers of Douglas fir plywood wall panels widen the choice range from the plywood dealer's stock.

Apart from the mere choice of panel arrangement, joint detail, and decorative finish, is the supplementary mill refinement of the plywood surface texture which also freely admits of further staining, glazing, multi-tone painting, etc.

One highly individualized texture provided by special mill treatment is an all-over rustic working of the panel facings. This texture is accomplished by etching away the light-colored and softer spring wood of the grain so as to leave the darker and somewhat harder summer wood in bold relief. This relief pattern is as varied and interesting as is the unusual character of Douglas fir natural grain, and in the hands of the finisher it imparts a surface suggesting the vagaries of the primeval. This specially-textured fir plywood is available in standard sizes of Wallboard grade and is proving immensely popular for the construction of false beams and featured paneling in recreation and game rooms, taverns, cabins, offices, lobbies, and wherever custom styling is important.

Another special texture being manufactured into the panel faces has so captured the imagination of creative decorators that they appear to be developing a vogue with it. This new specialty is a wall and ceiling plywood treated with an exclusive graining process that alters the characteristic appearance of the rotary-cut veneer, and imposes a smooth, even and refined grain pattern. This artificial grain is part of the wood and is as permanent as the wood itself. This product of the woodcrafters' skill requires no battens or mouldings to conceal joints. All panel edges are rabbeted so that when two panels are butted together, the joints become part of the tooled design. All panels are mill-treated with a resin sealer. These pre-finished panels are available in standard wall panels; 48″ wide x 8′, 9′, 10′, and 12′ long; and 48″ x 48″ ceiling panels.




MANY kinds of designs and size of paneling can be obtained by using mouldings of this type.

Another individualized wall paneling which brings a new mode of interior finish within the price range of the average decorator's budget and introduces an artistry suggestive of inlay and parquetry, is Douglas fir plywood panels employing various patterns of inlaid flush mouldings. Panel edges are rabbeted and joined with an ingenious method of using its own pattern to cover the joints. Joints are not only completely concealed, but actually contribute to the decorative scheme by breaking up plain surfaces into attractive decorative panels. These factory inlaid panels are available in four distinctive patterns, each of which is susceptible to all of the decorative finishes which may be applied to wood. For further variety, the patterns may be combined because, like the natural wood of which it is made, each has a basic note that blends with another, and produces a perfect harmony of effect. It is easy to apply on new or old work. It is stocked in standard sheets 48″ x 96″ and is accompanied with trimming mouldings.

Supplementary to the standard Wallboard grade of Douglas fir plywood and to the specialized wall panels, all of which employ rotary-cut veneers, there is yet another type of facing which adds still greater variety to the choice range—namely, edge grain or sliced veneer facings applied to standard panels. Replacing the interesting, if somewhat vivid, moire-like pattern of regular slash grain Douglas fir is the more restrained character of the uniformly colored parallel lines, alternately dark and light. These faces, applied to strong, warp-proof, split-proof plywood make a long-sought material available to the decorator and craftsman with which to achieve certain permanent effects heretofore unobtainable except at the expense of excessive bulk or the risk of fragility.

Only careful planning, not mere enthusiasms or happy

RUSTIC finished panels with narrow mouldings of light, smooth finish to accentuate the etched surface of plywood and to emphasize horizontal lines.

ABOVE is photograph of a distinguished living room paneled entirely with a special fir plywood. Finish, one coat enamel undercoater paint, one coat thin clear lacquer.

accident, can be relied upon to create decorative effects that serve the uses of gracious living. To remove the tediums and hazards from planning, a specialty moulding system, consisting of linear strips and junctions, tastefully and skillfully designed is available from dealers' stocks.

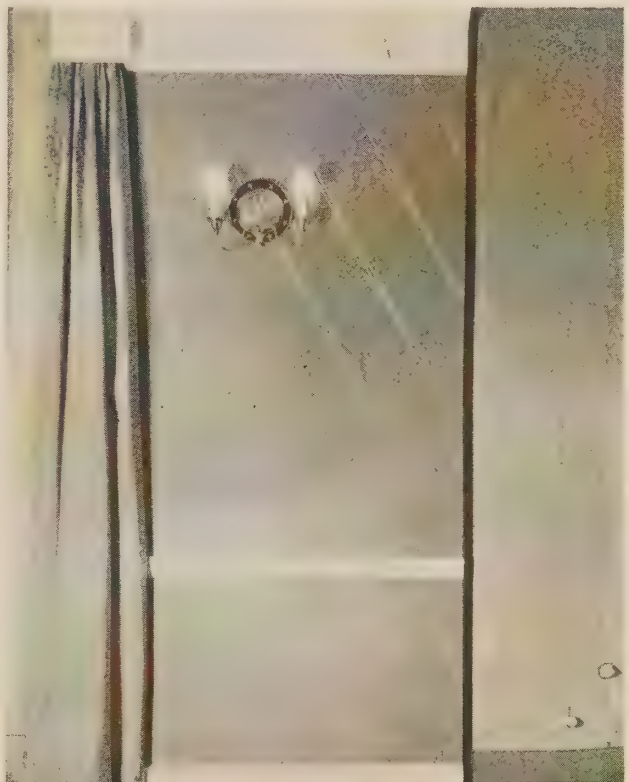
The linear moulding strips consist of gracefully designed panel mould, corner mould, and border mould which, when used with full rosettes, halves, and quarters, constitute a simple and dignified system for panel delineation.

The moulds may be used in conjunction with other standard mouldings. For example, the corner and border moulds, when used with standard coves, produce either flush type or offset cornices of unusual effectiveness. These specialty mouldings are inexpensive, more efficient, and quite as decorative as higher priced frame paneling.

Special panel crafting obtained by slight charring by blow torch, sand blasting, wire-brushing, and other mechanical means of altering surface texture, is done in the shop or on the job. Carving with hand chisels or power routers is sometimes resorted to in order to add variety. Briefly almost any treatment applicable to solid wood may be adapted to Douglas fir plywood.

The flexibility of plywood paneling means limitless opportunity for the expression of any period or architectural theme. Period—sharply modern, formal, informal, quaint, or austere—whatever the requirement for any distinctive home or business interior—walls of Douglas fir plywood are indicated because, with it, any shade of interior effect is obtainable and within reasonable cost range. With plywood, walls may be built which somehow just "fit," not only the tone of the surroundings, but also

BELOW is an Empire period wall treatment made of Douglas fir plywood grooved into a diamond pattern with a high speed electric hand router to cut through the surface veneer. Many such effects are easily obtainable.



the economic status of the structure. Worked with hand or power tools, plywood responds to the craftsman's skill. So: walls, decorative features, doors, and utilities may be tailored and personalized to fit the individuality of the owner. In one of the wall treatments photographed a foundation suggesting the formal "Empire" period was desired and, accordingly, panels of standard Wallboard grade of Douglas fir plywood were placed on a flat bench and marked off with a diamond-shaped pattern above the wainscot line and vertical groovings below, typical of the dominating decorative pattern of the period. Straight-edge guides, waxed to remove friction, were clamped into place, and with a high-speed electric hand router (readily available) the V-shaped grooves were cut to the depth of the face veneer. The routed panels were nailed into position on the studs and trimmed in keeping with the theme. The star-shaped medallions on the frieze were jig-sawed from plywood. After painting with semi-gloss in white and smoke-blue, the metal stars were nailed into position. Light fixtures and rich drapes are accentuating appointments.

In the same way, a Marine motif, required as the backdrop for an informal hobby room of a man who chose to use the spirit of the sea as atmosphere for his trophies, was easily produced. With fir plywood the idea was readily accomplished by simulating random vertical panels with slightly rounded grooves worked on a small table saw with dado attachment. Anchor-shaped appliques at the ceiling band were cut with a coping saw. A heavy Manilla rope was nailed into place to serve as picture mould. A "port hole" was cut with key-hole saw and a lighted shadow-box formed a niche for a treasured model. Paint completed the effect.

## Cabinet Work of Plywood

By minimizing piecing, and fitting, Douglas fir plywood's large size greatly reduces the cost of all kinds of casework, besides giving it split-proof, warp-resistant strength. Plywood's crossbanded construction eliminates swelling and shrinking and so cabinet drawers, bins, and doors made of it will never stick, and the joints will remain permanently tight and dust-proof. Shelving, nooks, and built-ins may be made with thinner pieces and plywood's strength capitalized upon to accomplish more graceful and appealing lines. Strength is an important feature in creating a preference for plywood breakfast room sets, sleeping bunks, ironing boards, window seats, and similar features calling for stability and shock resistance. The ease with which large pieces may be worked with hand or power tools and its affinity for glues also make fir plywood a popular cabinet shop material. Nails or screws may be placed closely to the edges of the panels without splitting.

## Built-ins Favored

The modern trend in design and construction has less regard for the "conventional" aspect and the form of things depends largely upon their practical function. Hence, home builders are given greater latitude with regard to the construction of conveniences and to attractive features which contribute to today's mode of living.

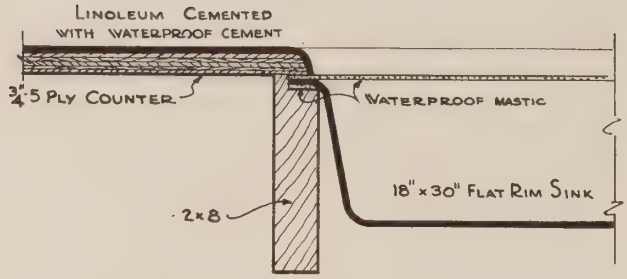
Fold-away items, such as, breakfast room sets, cabinets, bars, and game tables are popular for floor-space in a modern home and serve a variety of usefulness; thus, the trade is called upon to exercise a greater degree of skill than heretofore. Plywood's characteristics are ready-made for such demands and have contributed no small part in developing the taste and appreciation of such items.

Among the various grades of Douglas fir plywood used in construction, the most popular in cabinet work is Wallboard of 3 or 5-ply which is available in thicknesses, sanded, ¼-inch and ⅜-inch, 3-ply; or ½-inch, 5-ply. The panel faces of this grade are smooth and suitable for painting while the backs may contain blemishes unsuitable for exposure on good work. When both sides of the panels are to be finished for exposure a GOOD 2 SIDES grade should be used for natural or stain finishes, or SOUND 2 SIDES grade if the plywood is to be painted.

In the photograph opposite (1) fir plywood is in evi-

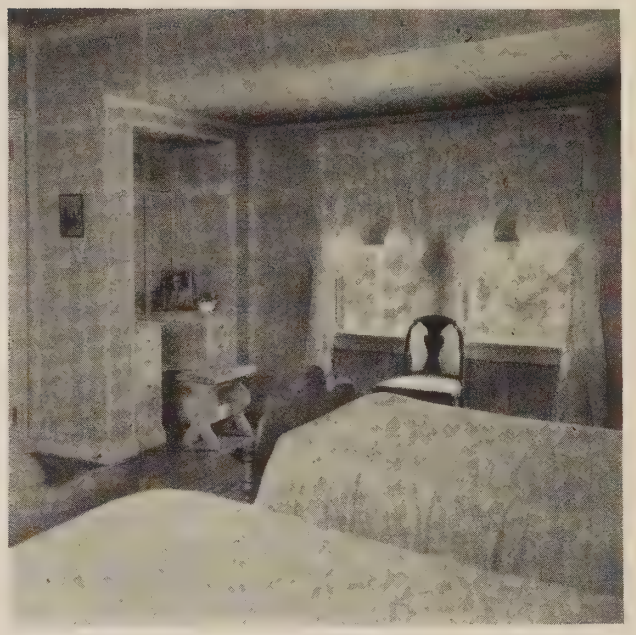
AN artistic modern use of fir plywood built-ins and interior paneling to frame nature's beauties.—Beatty and Strang, Madison, Wis., architects, use plywood effectively for cabinets and shelving.

FIR plywood's adaptability makes it popular for varied construction uses. Carpenters like this strong, straight material which permits them to do a good job quickly. Fixtures in this kitchen illustrated will express the latest in modern style.




° SECTION AT SINK °

PLYWOOD work counter top used by many builders and recommended by a prominent lumber manufacturer for its series of 1938 demonstration homes; ¾" Douglas fir plywood is used as base for mounting the popular linoleum counter surface.



THIS fir plywood dressing table is the pride and joy of its Atlanta, Ga., owner. Notice also attractive moulds covering plywood joints.

dence everywhere. The drainboard and cabinet tops, which are to be covered with rubber composition, are plywood; the shelves, cabinet backs, and dust boards are plywood; the floor, which is ready for linoleum is plywood, as are the walls which have been covered with felt as a base for washable wallpaper.

### Clothes Chutes and Elevator Shafts

Step-saving conveniences of sundry nature, including clothes chutes, dumb-waiters, and butler's service-passes are made of plywood because the material has many natural advantages for such uses.

### Air Ducts

The increasing demand for air-conditioning equipment has developed a new market for fir plywood. Cold air ducts for furnaces and air-changing equipment are now constructed quickly and economically by carpenter labor. Exhaust fan equipment in attics is housed in plywood cabinets and connected to the rooms to be ventilated. Gravity systems may be simply constructed by ingenious craftsmen by utilizing spaces between studs and joists. In any type of system the smooth surface of plywood contributes to the uninterrupted, frictionless flow of air.

FINISHED kitchen completely paneled and cabinetted with the ever popular Douglas fir plywood. This one is located in Burlingame, Calif.

# "I Like Plywood"

## Declares Joseph Weston, Architect

*JOSEPH WESTON, long prominent in Southern California architectural circles, was a student at the University of Pennsylvania School of Architecture, Bellevue School of Art, Paris, and is a veteran of the A.E.F. He has specialized of late years in the smaller type of residences and Group Housing and established an enviable reputation as architect on two highly successful Subsistence Homestead projects.*

IN A heavy conference not long ago in which the owners of a large property and their financial agents were assembled in solemn conclave, the question was asked, "Why do you use plywood?" Everyone stopped talking to await the answer and I did the best I could on short notice, "Because it is clean, dry, easy to apply, it will take any finish, and is strong—and we live in an earthquake country."

The story however goes much deeper, and my liking for the material is built on several basic foundations which include architectural education, the history of architecture, the economic practice of an architect desirous of working in the low cost field, modern materials and their "integration" into a plan which expresses the living demands of this age, and finally the actual construction of the building.

It appears to me that the source of the term "architect," that is "Master-builder," (look in Webster's if you don't believe it) is sometimes forgotten in thinking of the duties and responsibilities of the architect. Also, to make the situation more difficult the architect is expected to know not only heat, light, and sanitation, but construction in brick, concrete, steel, synthetics and wood. A little design is thrown in too, of course. Quite several mouthfuls to "master."

Well, anyway, in 1932, I decided to concentrate on wood, and have been having a "high" time ever since. I wish architectural schools would have every architectural student determine upon the basic material which appeals to him most, and then carry his design and engineering along with that material in mind.

After the determination upon wood, I went back to my history and found, among other things, that laminated wood, plywood, is an Egyptian art and that examples in perfect repair 3,500 years old exist in the Cairo and other Museums today. I don't know whether to laugh or get sore when some mortgage expert suggests that perhaps I'd better go slowly until plywood has proven itself. "Heavens alive!"—what proof is needed, his chair, his desk, his own front door, I'll wager are of glued up veneers.

Many architects are anxious to enter the low cost field, but their net profit being unforgivably slim as it is, they try to do what they can in this direction as a side line. This won't work, and the much tried stock plan has not produced satisfactory results.

The architect who wishes to do low cost houses, and at a profit, will have to commit his mind to the problem as a major endeavor. Then he will have to work on a segregated contract basis, with a selected group of subcontractors with whom he can operate in closest cooperation; or better, he may design and build himself, retaining his professional status by using the fixed fee basis.

Our office has turned to the latter way of handling our affairs. The focusing on one material, in one field, with complete control of all phases of designing and buiding has been a gratifying experience.

The next step was the adaptation of materials to a planning system which would permit repetition of parts without losing variety of plan.

We are all acquainted with modules, and with the "integrated" house, a modular system which has been ably presented. The question is, what unit of measurement is most practicable to adopt? After much discussion and trials of from one inch to sixteen feet, we took four feet as our standard.

Being partial to wood it was natural that the four foot sheet of Douglas fir plywood should fall into our scheme of things, and I can add that every expectation has been met.

Our plans are now all laid out on a four foot grid and we use plywood on all interior walls and ceilings.

The problem of the low cost house (1,800 to 2,500 dollars) is a tough one for the government to crack, and just that much harder for the private organization working without subsidy. It can be done, however, and I'm willing to prophesy that it will come about through the coordination of shop and field methods by more careful planning, which, with full knowledge of all operations, utilizes every experience and places in the most economical division, the work of prefabrication and assembly.

The future will bring completed elements of truckable size for one day assemble at the site. We have done two homes in this manner in which finished room units, twelve feet in width were ready for occupancy four hours after delivery. Any width over eight feet, however, becomes a house-moving job, and transportation costs, special fees, and a twenty dollar compensation insurance rate defeat the purpose of low cost. However, rural areas in states or on roads not controlled by rigid load width limits, could well be served today by such a method, and plywood with its great lateral strength makes an ideal material for such usage.

In the allocation of operations to shop and field, we find that shop nailing of plywood is much faster than where done outside. We therefore not only build our casework, frames, and trim inside, but build the walls and ceilings in four foot sections on the bench, and have just completed twenty-two houses in Atlantic Village, Long Beach, Cal., in this manner.

There is, of course, no middle line of taste, but this does not limit our use of plywood. On the walls we omit battens, not marking the panel divisions, and giving unbroken surfaces against which to place furniture. This permits, also, the choice of stain, flat paint, enamel or wall paper.

One happy combination of materials and finishes has been a natural plywood ceiling with redwood mouldings, warm white walls and solid color linoleum floor.

As to the use of plywood exposed on the exterior, we have only three buildings by which to judge, and so far these have perfect batting averages. It is our opinion that water does not present a problem, where the plywood is properly manufactured. We are curious, however, as to the action of dry heat and the actinic rays of the sun.

It goes without saying that we use plywood for an unlimited number of purposes other than wall and ceiling surfaces. Furring, case work, splines, doors, sheathing, and forms, are a partial list.

Need I say more as to why I like plywood—and use it?

# Douglas Fir Plywood in a 1937 Residence

**By LEA, PEARSON & RICHARDS, Architects**

PLYWOOD paneling, combined with careful detailing and workmanship, was used in a large eleven-room house recently completed in one of our residential suburbs. All of the rooms, excepting only the furnace room and a den were finished in Douglas fir plywood.

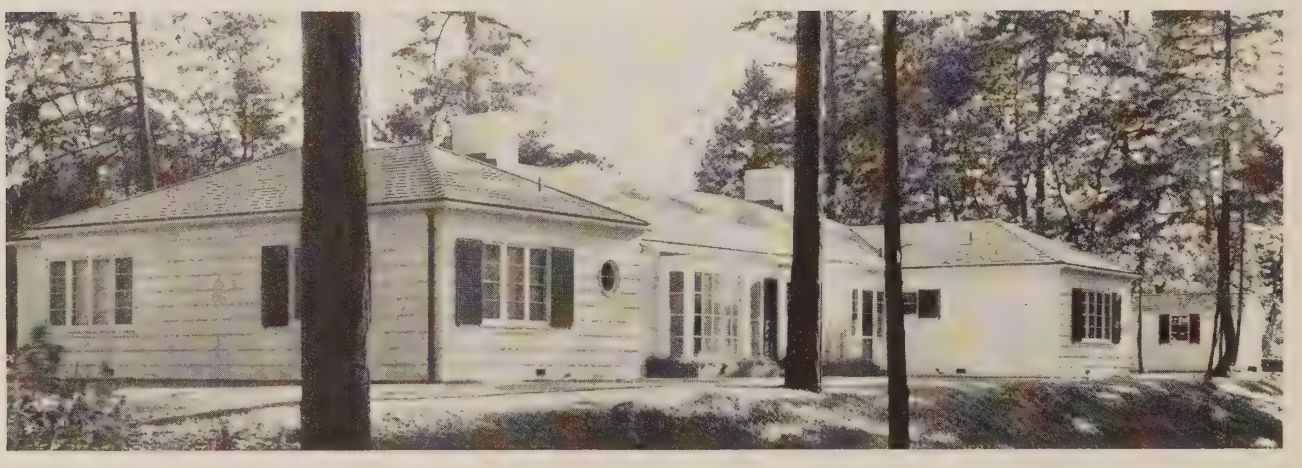
We used a Wallboard grade of plywood ¼" thick, with standard stud spacing of 16 inches. This produced a very satisfactory, rigid and smooth base for the finishes used.

The section in lower right hand corner of the accompanying detail shows method employed in fastening the plywood panels. The result was a perfectly tight butted joint. This joint when set, was covered with a paste filler and sanded, and the process repeated to make a smooth, unbroken surface. This same filling was used on any blemishes appearing on the plywood from handling. There were also some small nail holes to be filled, as the plywood had to be held in place until the glue had set. In all cases, before the filler was applied, the plywood was treated generously with "Rezite" to seal the wood.

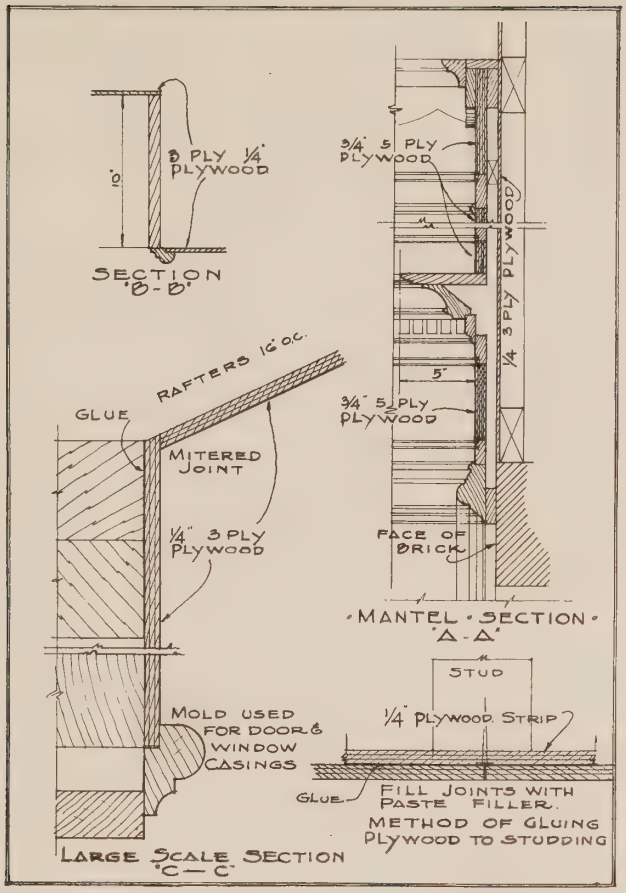
The photo on this page shows an end of the living-room with plywood paneling. Architectural details of this and of joints appear in the drawing.

Section "A-A" shows the use of ¾" plywood for heavier paneling around the fireplace. In this construction we used stiles and rails on these panels to allow for a bead moulding, which, at the time we did not believe could be accomplished in the plywood alone. We have

THIS lovely fireplace paneling, wall coverings and ceilings is of Douglas fir plywood. Details are shown on the opposite page.



DOUGLAS fir plywood was used extensively in this spacious woodland home designed by Lea, Pearson & Richards, architects.




**DETAILS** of wall finish in the beautiful library designed by Lea, Pearson & Richards, architects, as illustrated on page opposite.

found since that this could have been put in with a square router and the edges sanded to round the bead into the desired effect.

Section "B-B" shows the type of casing used in all the rooms for window and door trim and for cased openings as well as the bookcases.

In section "C-C" we have shown the mitering of the ceiling plywood to the wall plywood. This miter cut was done on the job without the use of power saw, yet the joint is as clean as if the material were actually bent to conform to the contour of the studding.

The painted finish had for the final coat, a brush-stippled semi-gloss or eggshell finish which produced a fine texture to the surface, and an appearance with which we all were pleased.

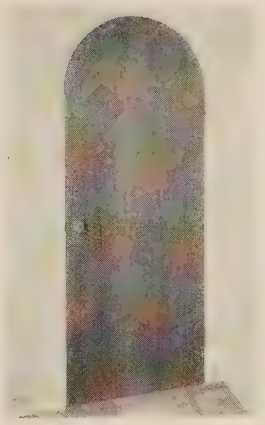
The workability of the panels and the finish obtained on this job have convinced us of Douglas fir plywood's adaptability as an interior finishing material.

## Douglas Fir Plywood in Doors

The Douglas fir door industry is one of the largest consumers of the highest grades of Douglas fir plywood.

Plywood door panels have replaced the old solid, raised panels so completely that today raised panel doors represent only a small percentage of the output. Some appreciation of the popularity of this type of door can be gained by considering that about fifty million square feet of Douglas fir plywood are used in doors every year.

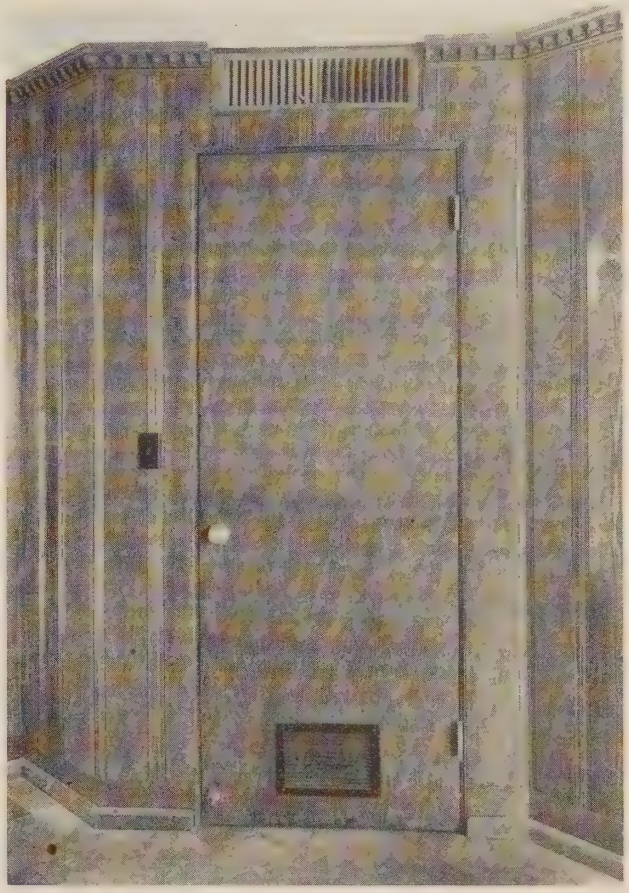
The growing popularity of the slab, or flush, door which harmonizes so nicely with the modern trend in



**PHILIPPINE** mahogany veneer over Douglas fir core makes this beautiful door used in a Miami, Fla. residence, and furnished by a Fort Lauderdale dealer.

interiors is increasing the demand for the door industry of Douglas fir plywood. Slab doors require high grade faces the full size of the door and for this purpose plywood is ideal. Many of these doors are built with hollow cores to lessen their weight; the plywood faces, acting as a stressed covering, combine with this type of core to produce a strong and lightweight door.

The demand for flush doors in modern kitchen cupboards has been met by the use of ¾-inch, 5-ply Douglas fir plywood and to some extent lately by a hollow core door similar in design to the large slab doors but with thin plywood faces. In the meantime, panel doors for cupboards are still very popular and for these Douglas fir plywood is used for the panels.



**DOUGLAS** fir streamliner door in a Miami Beach, Fla., office building. Adjacent Douglas fir paneling matches for grain and coloring.

# New Prefabricated Plywood House at Forest Products Laboratory

By R. F. LUXFORD*

EARLY in 1935 the Forest Products Laboratory built its first prefabricated plywood house. Another one-story prefabricated plywood house consisting of a living room, kitchen, two bedrooms, bathroom, and utility room has just been erected on the grounds of the Forest Products Laboratory at Madison, Wisconsin. This new house incorporates the latest findings in housing research. These findings include among other things the use of plywood made up with synthetic-resin adhesive, and provision of moisture barriers within wall, floor, and roof panels. Other interesting features of the new construction are the use of mineral insulation material to increase fire resistance in addition to giving necessary heat and sound insulation, and provision of plywood floors with ⅛-inch hardwood veneer as wearing surface.

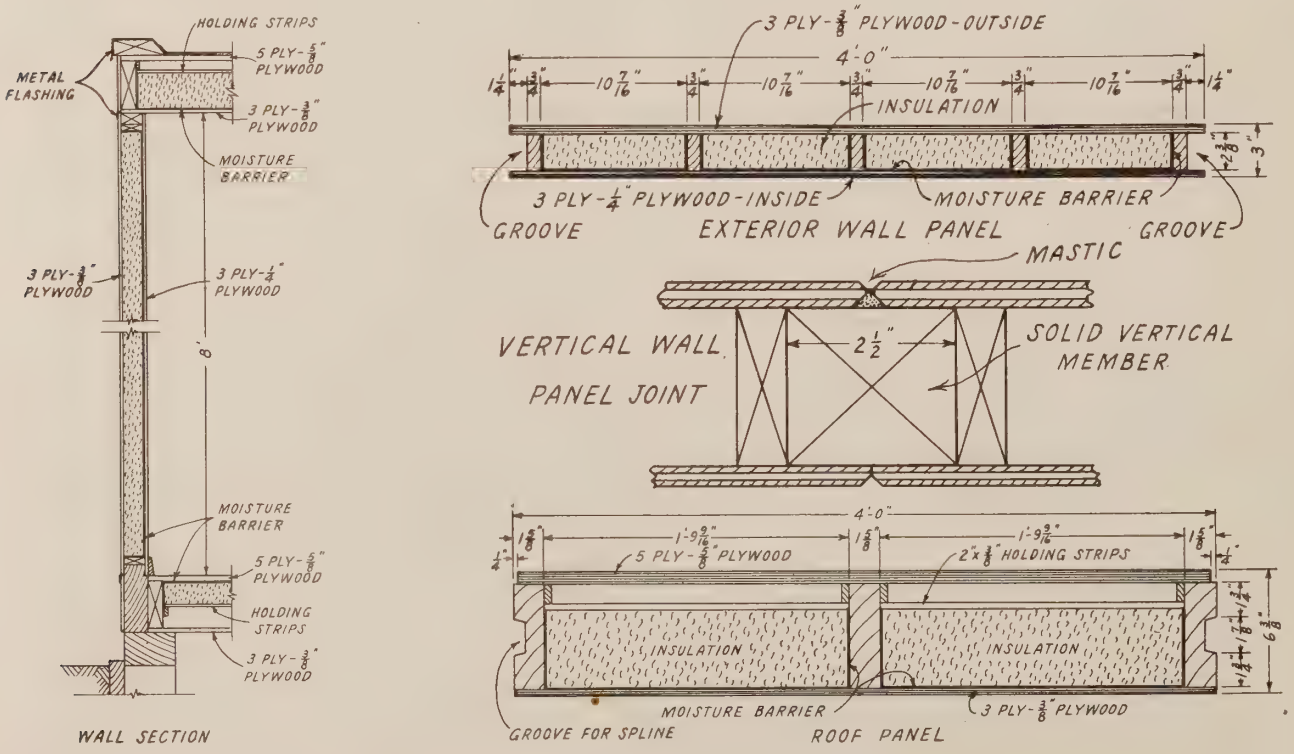
This house will serve both as an example of the prefabricated method of all-wood construction and as a test of its permanency under actual weather conditions. The house may also serve for the purpose of obtaining additional research information such as the efficiency of the moisture barriers and thermal insulation used.

The new house is a basic example of a system of prefabricated all-wood construction developed in line with modern structural research and modern wood fabrication. The system is based on the use of standard units, sections, or panels to be made in large quantities by factory methods, and then assembled quickly and without waste on the site. Its ultimate success will depend on good workmanship and technique in the construction of the plywood and house units, accurate dimensions of units, and efficient painting practice.

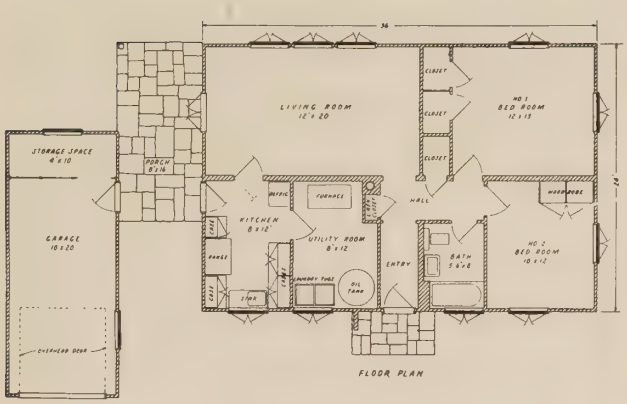
Each panel in the Forest Products Laboratory system of prefabricated construction consists of two plywood faces glued to either side of an inner structural framework to form what is virtually a box girder. While the use of plywood is much in evidence in this new house it is interesting to note that the number of board feet of lumber approximates the number of square feet of plywood.

The differences between the Laboratory's panel system and the conventional type of construction are marked. To choose an example at random, in the conventional type of floor construction the subfloor and finish floor are nailed to relatively deep joists. The subfloor is nailed diagonally in order to stiffen the building, but it is of little benefit to the strength of the floor framework. In contrast to the foregoing, each panel in the Laboratory's system has a complete and continuous rigid joint between the plywood and the framework formed by the glue between the plywood and joists. This causes the entire panel to act as a unit like a box girder and as a result the floor panels will deflect only about one-quarter as much under a given load as the joists acting alone.

*Senior Engineer, Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, maintained at Madison, Wis., in cooperation with the University of Wisconsin.




DETAILS of construction of new prefabricated plywood house developed at the Forest Products Laboratory, Madison, Wis., and illustrated on the three following pages.



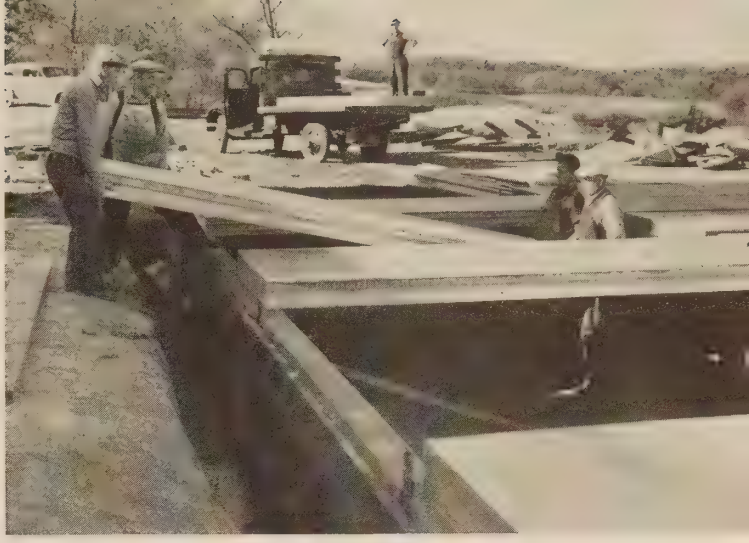



PHOTO above shows floor panels being assembled on foundation at Forest Products Laboratory Plywood house.

## Wall Panels

A typical wall section, 4 by 8 feet in area, is shown in details opposite. The exterior panels are 3 inches in thickness and consist of ⅜-inch three-ply plywood on the outside, and ¼-inch three-ply plywood on the inside. The framework consists of vertical members made of 1-inch material 2⅜ inches wide, spaced approximately 12 inches apart with two end headers to which the plywood faces are glued. The partition panels are also 4 by 8 feet. Both faces of the partition panels are, however, of ¼-inch plywood, and the vertical members are 2½ inches wide, the overall thickness being 3 inches.

Experiments indicate that these panels when tested as a beam require a load of more than 200 pounds per square foot to cause failure. A 60-mile wind has a pressure of about 12 pounds per square foot, which is approximately one-seventeenth the load required to break the panel.

The plywood projects beyond the framework of the panel forming a continuous right-angle groove 2⅜ inches wide and 1¼ inches deep entirely around the panel. A portion of the sill fits up into this groove. A 2½ by 2⅜-inch solid vertical member is fitted into the grooves on the sides of adjacent wall panels. This vertical member serves as a connecting piece between panels, and also carries a part of the roof and floor loads. At the roof a strip glued to the roof panel fits down into the groove at the top of the panel as shown in the details. After assembly the wall, floor, and roof panels are securely fastened by screws or nails to those parts which fit into the groove, tying wall, foundation, and roof together.

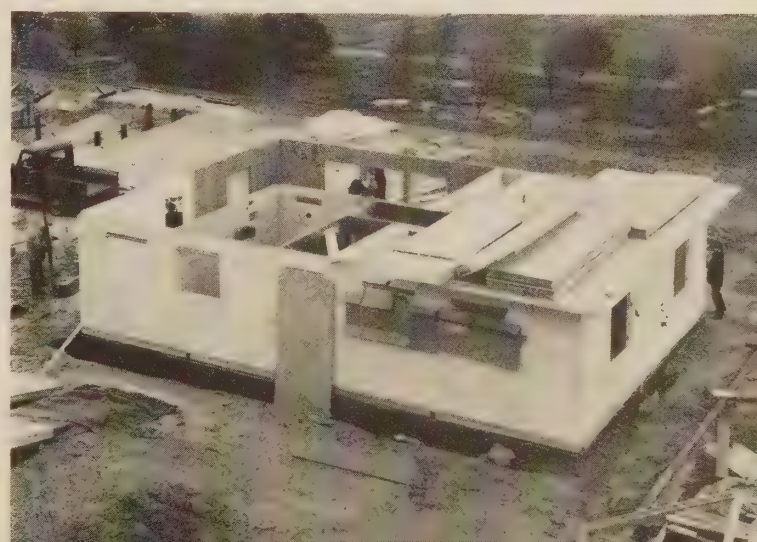
The edges of the face of the panel forming the interior house wall are beveled to form a V-joint when the panels are assembled. The panels forming the exterior surface are beveled on the outside and inside edges, the outside bevel to form a V-joint similar to that for the interior wall surfaces, but slightly opened and the inside bevel to form a pocket for mastic which is placed between the panels directly after erection. This pocket prmits a sufficint amount of mastic to be placed between the panels so that it will remain plastic indefinitely, and thereby make a tight and permanent seal against the entrance of moisture and infiltration of air at the exterior panel joints.

## Floor Panels

The floor panels are 4 feet wide and 12 feet long. The upper face is ⅝-inch plywood of five plies, and the lower face is ⅜-inch plywood of three plies. These faces are glued to a structural framework consisting of three nominal 2 by 6-inch members spaced approximately 24 inches

ABOVE: Wall panels and partition panels partially assembled;

BELOW, all exterior wall panels in place and roof panels being assembled.



THE new prefabricated plywood panel house at Madison, Wis., designed and built by the engineers of the Forest Products Laboratory. Photo shows all panels in place and house completed.

apart, with end headers. All parts of the panels act as a unit and therefore the panels can be substituted for the usual 2 by 10-inch joists spaced 16 inches apart as ordinarily used in house construction.

The lateral edges of the floor panels are grooved to permit a spline connection for the distribution of weight to adjacent panels. When panels of this type are tested as a beam over a 13½-foot span, more than 300 pounds per square foot are required to cause failure. Accordingly, the panels far exceed in strength any loads normally put upon them.

With the exception of the kitchen and the utility room, the upper 5/8-inch plywood is faced with birch 1/8-inch thick to form the wearing and finished floor surface. This construction eliminates the necessity of putting a finished floor over a subfloor as in ordinary construction.

## Roof Panels

The roof panels are similar to the floor panels in construction. The top plywood covering of the roof panels was cut back ¼ inch to allow a groove between the panels, and this groove was filled with a caulking compound. With this size of groove it is believed that the caulking compound in the joint would remain plastic for a long time and, therefore, form a better and more permanent seal. After the joints were filled, the entire roof was covered with a material similar to a thin caulking compound.

## Kind of Plywood

All exterior surfaces of the house described here are of hot-pressed resin-bonded plywood. The use of plywood in the past for outside permanent construction has not always proved satisfactory because the glues available were not sufficiently resistant to weathering. With the introduction of the resin type of glues this situation has changed. At present plywood glued with the hot-pressed resin glues is being used more and more for outside use with every indication that it will withstand the weather indefinitely without the plies separating, provided ordinary care such as painting the edges and surfaces is used. Resin-bonded plywood has also been used for interior surfaces because of its somewhat greater fire resistance which will be mentioned more in detail later.

## Moisture Barriers

Coincident with the introduction during recent years of more moisture into homes by means of humidifying apparatus, houses are also being made tighter by the use of storm windows, weather strips, and the more general use of insulation within the walls and roofs. In houses loosely constructed, the moisture-laden air, which flows from the warm inside toward the outside, is easily carried away; however, in houses with good insulation and tighter construction, either of conventional type or prefabricated, the moisture is not easily carried away, and when it reaches the cooler areas within the wall it condenses. Over extended periods considerable moisture accumulates, the insulation becomes wet, and its efficiency is greatly reduced. Even when warm weather arrives the moisture disappears slowly and makes conditions favorable for rust, mold, and decay. Many paint problems, such as the peeling of outside paint, also arise from the accumulation of moisture within the walls. Obviously it is very important to prevent such conditions, and, therefore, moisture barriers have been used in the outside walls of this house.

The moisture barriers used consist of asphalt-impregnated and coated paper weighing 50 pounds per 500 square feet. The barriers are placed within the panel and against the back face of the inner walls, against the back of the upper face of the floor panels, and against the back of the lower face of the roof panels; that is, in all cases the moisture barriers are placed within the panels and against the back of the face nearest the inside of the room.

A moisture barrier is placed in each space between framing members, and consists of a single piece of paper so folded as to fit snugly against the plywood face and along the sides of the framing members. Those parts of the sides of framing members that are in contact with the moisture barriers were given a brush coating of asphalt paint just before the barrier was placed, after which the barriers were held to the framing members with wire staples at intervals of not more than 6 inches to keep the paper tightly against the framing members and in contact with the fresh asphalt paint.

## Insulation

The walls of the house are 3 inches overall with a 2½ or 2⅜-inch inside space, depending upon the thickness of the plywood used. This space is entirely filled with a mineral wool insulation giving a coefficient of heat transmission for the wall of approximately 0.13. This is superior to ordinary construction with ½ inch of blanket insulation.

In addition, the use of large plywood sheets in wall panels is very effective in making the structure wind tight. Insulation has also been placed in the partition walls for sound-leadening purposes.

The floor panels are insulated with nominal 2-inch mineral wool bats and the roof panels with 4-inch bats.

## Fire Resistance

Fire tests at the Forest Products Laboratory of plywood show that the plies of vegetable-glued plywood separate while burning whereas the plies of resin-bonded plywood do not. Resin-bonded plywood will therefore give somewhat greater resistance to fire than will plywood glued with a vegetable glue. On this account, and also because it offers somewhat greater resistance to the passage of moisture, resin-bonded plywood was selected for the inside walls as well as the outside walls.

To obtain greater fire resistance a mineral wool of high density was selected as an insulating material.

## Description of the House

The floor area of the house is 24 by 36 feet. The house includes a 12 by 20 living room, kitchen, two bedrooms, bath, connecting halls, and utility room. In addition there is a coat closet and a linen closet off the main hall, two closets in the larger bedroom, and a wardrobe closet in the smaller bedroom. Placed close to the house there is also a large garage, with a space at one end partitioned off for storage. The garage is connected to the house by a roof made of roof panels.

The living room walls are of birch finished natural, while the ceiling is painted a light color. The floors are of birch-faced plywood, as are all other floors, except the kitchen and utility room, which are of Douglas fir plywood. The walls of the hall are also of birch finished natural. The walls of the other rooms are of Douglas fir painted.

The house is heated with an oil burner. A warm air forced circulation system is used, and the heating ducts are confined mostly to that portion of the hall connecting the various rooms. This portion of the hall has a lowered ceiling to accommodate the ducts.

BEDROOM of prefabricated house with painted Douglas fir plywood walls and ceiling, and plywood floor.

A post and plank foundation of creosoted wood has been used.

John W. Root of Holabird & Root, Chicago, was consulting architect, and the Goodwillie-Green Box Company, Rockford, Illinois, were the contractors.

In prefabricated houses there is a decided tendency toward one-story homes. It is, however, both practical and feasible to erect two-story houses with prefabricated panels as constructed by the Forest Products Laboratory. Plans for such a house have already been prepared. The units for this house are now being built, and the house will be erected on the Laboratory grounds near the one-story house here described.


LIVING room showing birch walls and window trim. Joints of floor, wall and ceiling panels form continuous lines around the room.


# Low-Cost Plywood House

## Dri-Bilt House at Gibsonburg, Ohio, Has Unique Features Shown in Details on the Opposite Page

FLOOR PLAN and construction details, house shown opposite; how plywood is used in standard sizes to effect major economies.

THE Gordon Lumber Co., Oak Harbor, Ohio, in co-operation with contractor-builders, is producing and marketing some interesting low-cost plywood houses in a number of Ohio cities and towns. The houses have specifications that read like a Who's Who of building materials and equipment. They get 80 per cent FHA loans, yet can be offered for as little as $22.50 a month. The house illustrated above was sold as a "lock-and-key" job for $3,590.

A number of the houses are basementless. All have special features, and economies made possible by using familiar materials in new ways. The oil-burning, forced circulation, warm air heating plant is placed in a centrally located heater room. The spaces between 2″ x 2″ sleepers beneath the floor are part of the heating system. They open into a central vent that extends across the entire building and connects with the cold air return of the heating unit.

The outstanding economies are effected, however, by using plywood sheathing, sub-flooring, and inside-wall paneling. Plywood sheets are laid horizontally, so that standard or pre-cut lengths can be used throughout. Horizontal edges meet over ribbons dadoed into the studs, so that tight joints are made at edges. Inside walls and ceilings are finished with moulding strips and wood rosettes, so as to produce paneled effects at a fraction of their former cost.

Walls can be finished for paint, paper, or canvas if desired, by using invisible glue joints. A plywood ribbon gusset is dadoed into the studs at points where the sheets will meet. The ribbon is coated with glue and plywood wallboard panels are set in place, then bonded before being securely fastened with finish nails. Glue oozes through and seals the joint between edges of the plywood sheets. The surplus is removed with a hand scraper after the glue has dried thoroughly. In this way a perfectly smooth joint can be made.

### Outline Specifications

FOUNDATION: 8″ concrete or concrete blocks, 3′ below grade on a 16″ x 6″ concrete footing. Slab of 3″ wire mesh reinforced concrete laid over a fill.

WALLS: Wood siding or red cedar shingles on 5/16″ 3-ply Westboard fir sheathing. Weyerhaeuser Guide-Line framing. Inside walls, 3-ply Westboard panels, wallboard grade, finished with DeVoe & Raynolds velour flat.

INSULATION: Rock wool in ceiling.

ROOF: J-M asbestos shingles, copper flashing.

FLOORS: Tempered hardboard, oak, fir, or yellow pine on 5/8″ Westboard, sheathing grade, on 2″ x 2″ treated wood sleepers.

TRIM: Westboard trim, rosettes, half- and quarter-rosettes, and mouldings.

MILLWORK: Curtis kitchen cabinets.

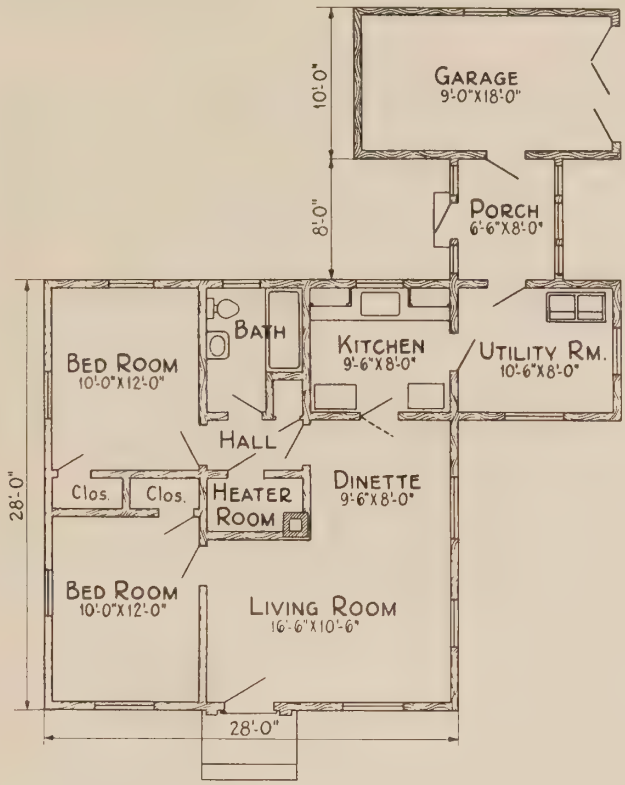
WINDOWS: Curtis Silentite, with Mitertite trim.

WALL FINISH: J-M asbestos flexboard wainscoting in kitchen and bath.

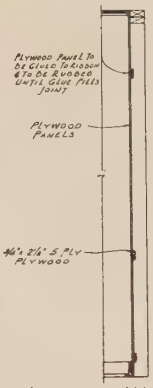
EXTERIOR PAINT: Devoe & Raynolds two-coat system.

HEATING: Duo-therm oil burner, forced circulation, or Bryant gas heater.

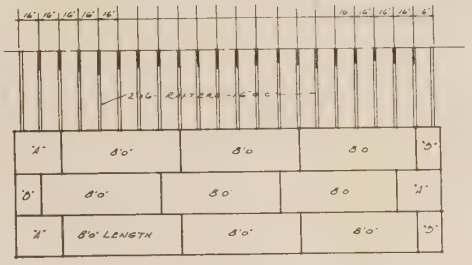
PLUMBING: Standard Sanitary enamel ware and fixtures.




FLOOR PLAN

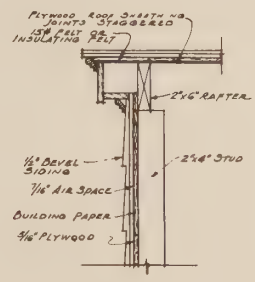



INTERIOR WALL SECTION

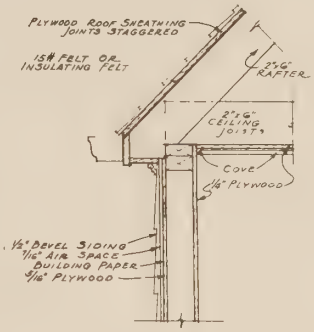



DETAIL SHOWING PLYWOOD ROOF SHEATHING

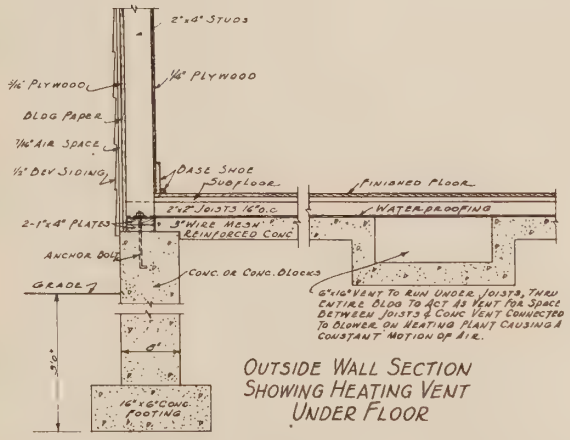
'A' CUT FROM 6'0" LENGTH
'B' CUT FROM 5'0" LENGTH



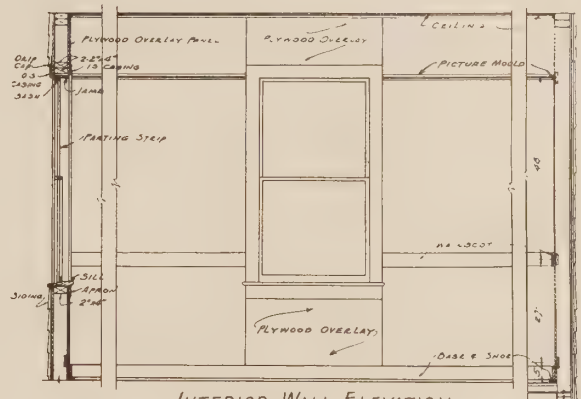

RAKE DETAIL



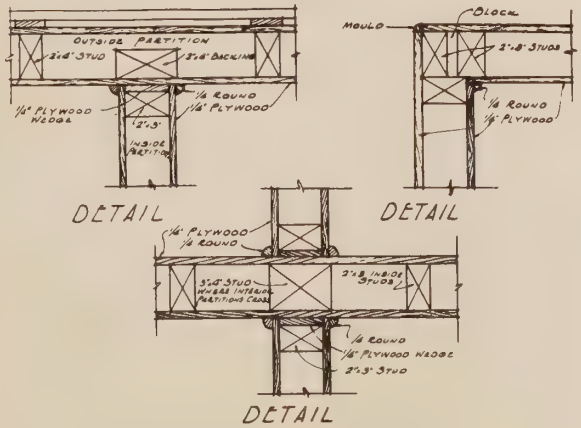

CORNICE DETAIL



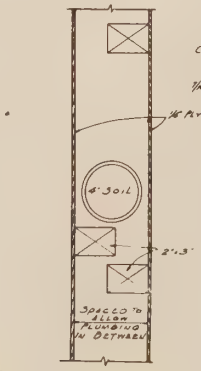

OUTSIDE WALL SECTION SHOWING HEATING VENT UNDER FLOOR



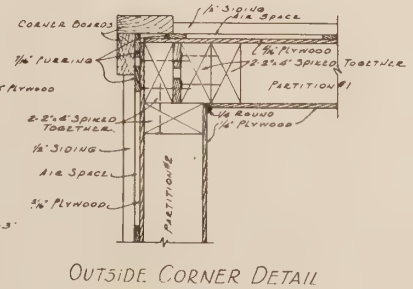

WALL SECTION — INTERIOR WALL ELEVATION — WALL SECTION



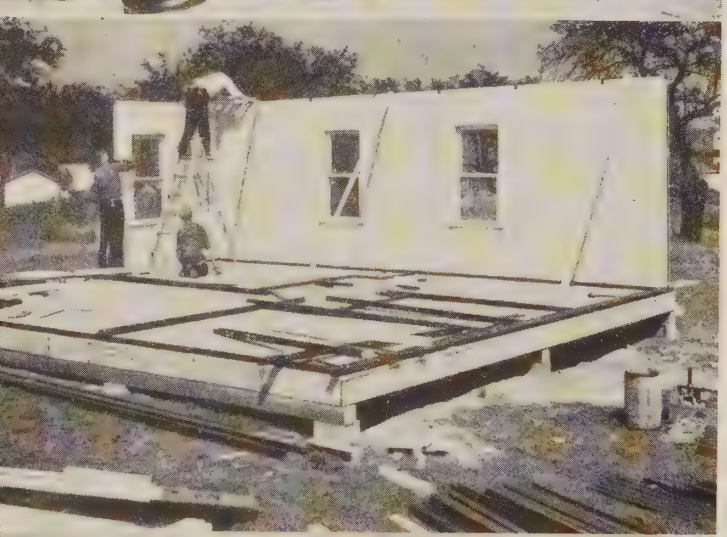

DETAILS SHOWING METHOD OF JOINING PARTITIONS

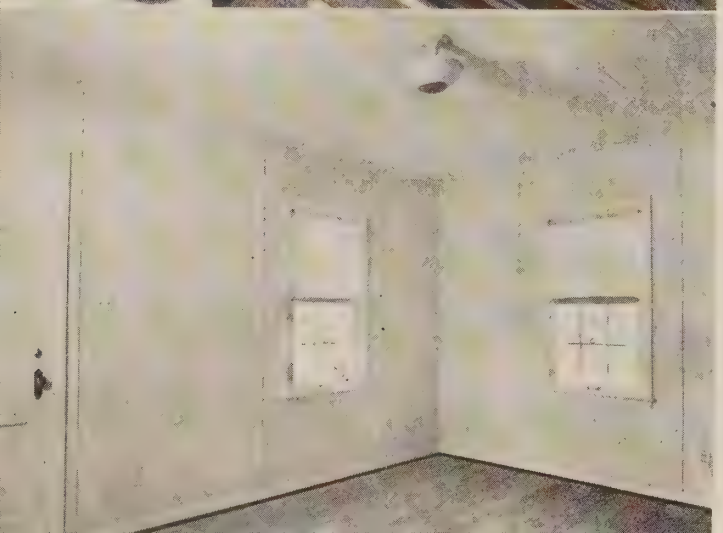



SOIL STACK WALL DETAIL




OUTSIDE CORNER DETAIL





# Plywood Interiors Used in New Stran-Steel Panel Homes

THE new type of prefabricated home recently introduced as the "Stran-Steel Composite Panel" home by the Stran-Steel Division of the Great Lakes Steel Corporation, Detroit, utilizes panels made in the lumber yard with plywood on the inside attached to wood studs and rigid insulation board on the outside. Doors and windows are likewise fitted into these panels at the lumber yard.

The panels are delivered to the contractor at the site of the home where they are locked into Stran-Steel channel and stud framing. Wood, brick or shingles may be used for the siding and any type of roofing material. Battens of wood cover the joining of the plywood inside walls which are finished with paint. The ceiling insulation board is cut to resemble tile. The house can be erected in a week.

An important feature of the house is the "skyscraper" construction with Stran-Steel framing throughout. The patented nailing groove of Stran-Steel framing permits nailing of wood or other collateral material direct to the steel.

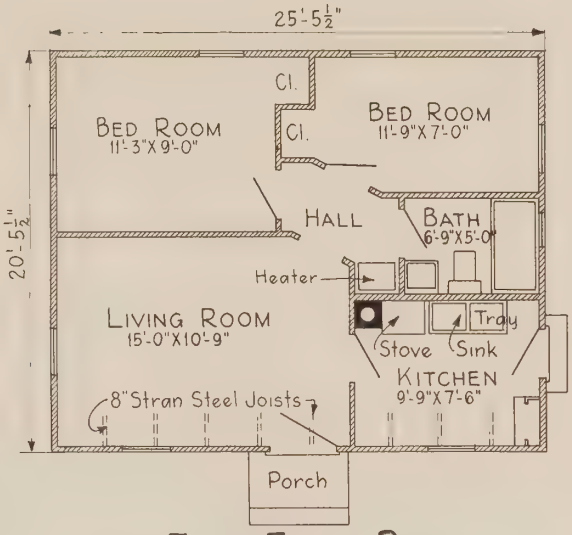
The model home constructed, with wood siding and asbestos shingle roofing, can be sold complete, ready for occupancy, for between $2,500 to $3,000, depending upon local real estate costs.

The four rooms of the model house are living room, kitchen and two bedrooms, each of the two latter with a clothes closet and doored-cupboard. The kitchen has an enameled sink and tray for laundry, and cooking is done by electricity, gas or oil. Circulating heat from an oil burner, housed in a hallway niche, provides warmth at a low cost. The bathroom has modern regulation equipment.

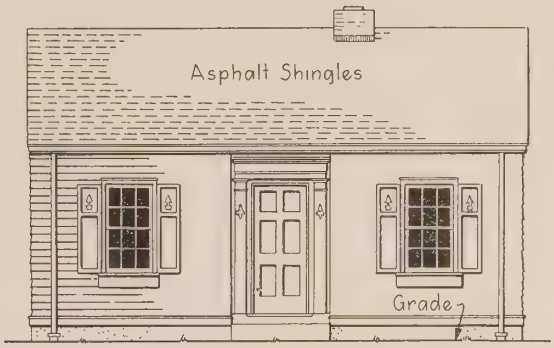
This approach to the low-cost home brings the cost well within the pocketbook of the average wage earner. It will permit prefabricating practically on the ground; the paneling will be done by local lumber dealers and the erection by local contractors. These homes will not be built by Stran-Steel. This system is especially adaptable to large projects where benefits of mass production will mean substantial savings.

**LEFT, TOP TO BOTTOM:** The first Composite Panel home designed by the Great Lakes Steel Corporation as it appears erected in Ecorse, Michigan; 54 hours is the time required for assembling the super-structure of this size house. Close-up shows a window panel as it comes from the lumber dealer and is set in place after the foundation, sills, joists and sub-floor are ready. Windows, doors and regulation Composite Paneling are locked together by the Stran-Steel studs and horizontal members. The section of living room in first Stran-Steel Composite Panel home shows batten-covered plywood wall finish.

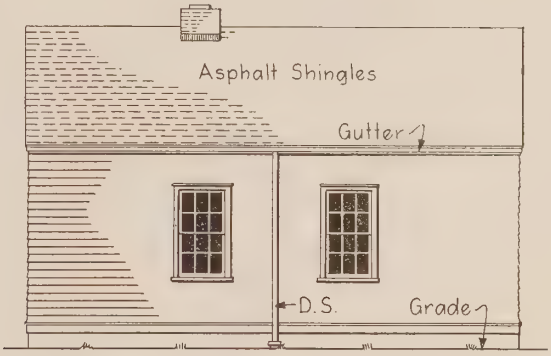
**OPPOSITE PAGE:** Floor plan, elevations and construction details of Stran-Steel Composite Panel home.



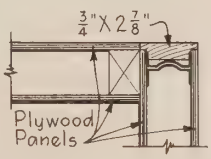

FIRST FLOOR PLAN



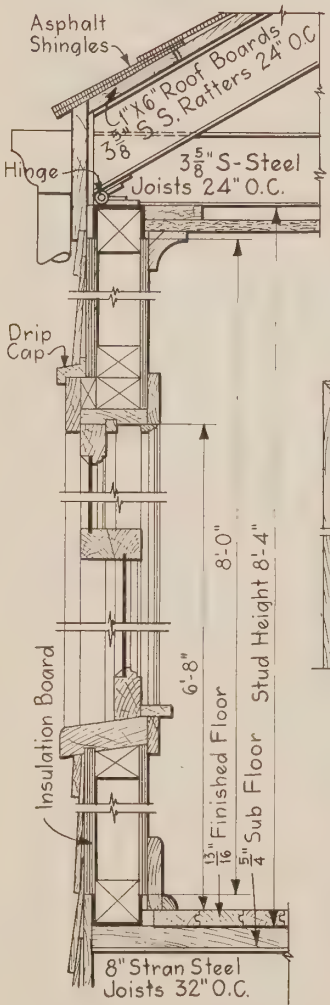

FRONT ELEVATION



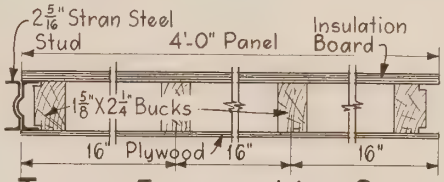

REAR ELEVATION



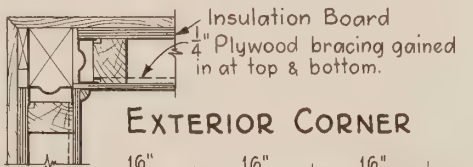

INTERIOR CORNER



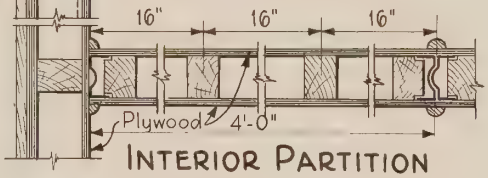

VERTICAL SECTION



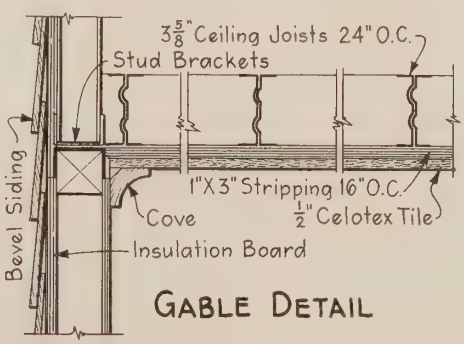

TYPICAL EXTERIOR WALL PANEL



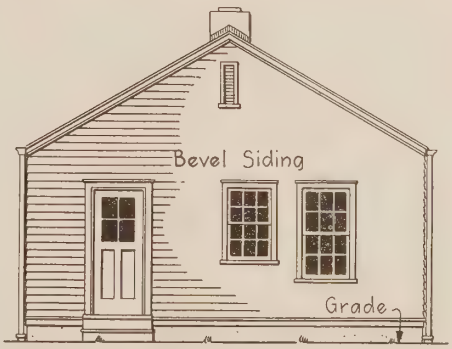

EXTERIOR CORNER



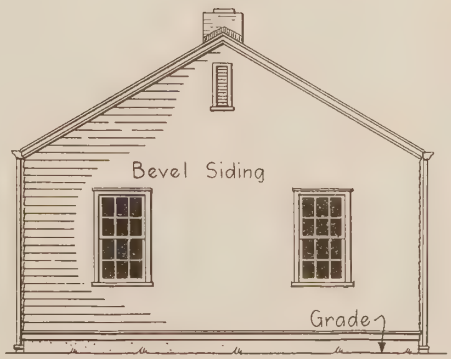

INTERIOR PARTITION




GABLE DETAIL




RIGHT SIDE ELEVATION




LEFT SIDE ELEVATION

# Stores and Shops Go Modern

NO division of tradesmen is more keenly aware of the influence of store decoration than those catering to women. Women, it is said, are more sensitive to beauty and respond accordingly to a greater degree than men. That is why the exclusive caterers, particularly in fashion goods, exert unusual effort to provide comfort, convenience, eye appeal, and that intangible quality known as "glamour" to their shops and salons. To a degree all trade reacts similarly. Little wonder, then, that successful and alert merchandisers are continually modernizing their stores. The old sales adage, that "goods well displayed are half sold," is as sound today as when it was coined generations ago.

Douglas fir plywood, because of its diverse qualities, is playing an increasingly important part in providing the "correct atmosphere" for goods and making it easy for a shopper to say "yes."

People regard the friendly warmth of feeling and the substantial appearance of walls and fixtures of wood, which have been designed with an eye to beauty as well as utility, as the key to the personality of the store. "Initial impressions—in store operation, as in other things—are important, and it is good business to recognize their value," is the conclusion reached by the committee of the United States Department of Commerce, who recently completed a study of Store Modernization Needs.

Today's decoration trend is definitely to the modern "streamline" effects with emphasis on horizontal lines. The effect of clean lines, unimpaired by profuse decoration with a rational flow of the surfaces into functional features, is the mark of the modern decorator. How the giant panels of fir plywood fit into such a theme of decoration is attested in the accompanying pictures. A harsh note is felt in the old type store which is completely out of tune with the times, and which exemplifies the need of things made with plywood. The same storeroom can be keyed up to the modern tempo. The cases, display table, fitting booths, and partitions all should be made of fir plywood.

The modern effect is being successfully achieved by the correct utilization of plywood's inherent characteristics.

**PLYWOOD as a background for beauty in hats—in high, wide and "what have you?" styles.**

**THE artistry of the decorator and the skill of the craftsman fashion fir plywood into walls of simplicity and distinction.**

Display tables are of 1 3/16", 7-ply, Good 2 Sides grade. Rounded corners on showcases are accomplished with 3/16" Good 1 Side while the rounded corners of partitions are done with ¼" Wallboard grade.

Illustrated is another store brought up to current standards with Douglas fir plywood. Here the material is in evidence everywhere. The concealment of panel joints graphically demonstrates plywood's response to the craftsman's skill. The grilles over the doors are jig-sawed from plywood and painted. Paint decoration is semi-gloss. Metal mouldings, balustrades, and cashier's grille offer contrasts and further indicate a tasteful use of materials.

Douglas fir plywood finds its uses for constructing false ceilings, covering pillars, air and light ducts, and a host of special features. Counter and cut-out displays are made of it because of its strength, smoothness, and workability.

Window backings of fir plywood have long been popular with construction and designing people. The large lightweight panels may be handled easily if the window back is of the removable type. This type is currently popular in many sections of the country for the reason that decorations may be applied in the window-dresser's studio and after completion, brought to the window for exchange with those panels which have served their period of display.

## Office and Store Partitions

One of the first uses to which Douglas fir plywood was put was in the construction of panel partitions. The suitableness of the product for this purpose is still unsurpassed. Today, partitions of permanent and standardized removable units, utilizing the primary characteristics of the giant plywood panels are used in offices, stores, schools, churches, and other places where interior space division is required.

In store equipment, plywood partitions for fitting rooms, private booths, department divisions, stock rooms, and many other similar places, the large warp-proof, easily decorated, panels are widely used.

The grades and thicknesses selected for such purposes depend, of course, on the ultimate appearance and the service required. The standard Wallboard grade is often used where only one side is to present a decorated surface, but more often both sides are finished, in which event the GOOD 2 SIDES grade is required for stained or natural decoration, and the SOUND 2 SIDES grade if paint is to be used.

Interchangeable standardized units are constructed utilizing plywood panels in conjunction with various types of rabbeted stiles, plates, and trimming units to conceal joints. Flush joints with open or concealed fastenings are also made as are frank V joints alone or with additional routed grooves to suggest narrower vertical paneling.

FITTING Douglas fir plywood for restaurant booths. These strong, wide sheets make this a popular material for such uses.

* * *

## From a Satisfied User

Morris, Ill.

To the Editor:

In the new home I built last season, I used fir plywood, not only in the kitchen and two baths, but in the living room, front hall and dining room, and covered same with carpet. It is working out very nicely.

J. & R. BEAUTY LUMBER CO.

By Henry Newman

PLYWOOD partitions, sturdy and rich, used in this Los Angeles office.

# Plywood Forms for Concrete

THE phenomenal increase in the use of Douglas fir plywood for concrete formwork, is attributable, in the final analysis, to one vital factor—*PLYWOOD saves the contractor money.*

This saving is effected by the inherent characteristics of plywood, and includes reduction both in material costs through repeated uses of the same panels, and in labor costs through ease of handling, workability, large panel sizes, smoothness, minimum of joints and consequently little or no rubbing.

From the massive concrete piers of a monumental bridge to the lowly basement walls of a housing block, fir plywood offers the contractor an efficient, economical medium.

To the architect, seeking new beauties in concrete masonry through an artistic arrangement of ornamentation, backed with smooth, plain surfaces, plywood offers a modern implement.

A special Douglas fir plywood grade, known as "Concrete Form Panels" is made for these ever-growing services. This grade is made with a special glue, exceptionally high in water-resistance, although not to be confused with the synthetic resin hot-pressed glues. Nevertheless, the Concrete Form Panels achieve the purpose intended as evidenced by thousands of jobs all over the country. Fifteen to twenty re-uses are common for these special panels, one of the best known applications being for the concrete roadway of the new San Francisco-Oakland Bay bridge, as well as the viaduct approaches for the Golden Gate bridge.

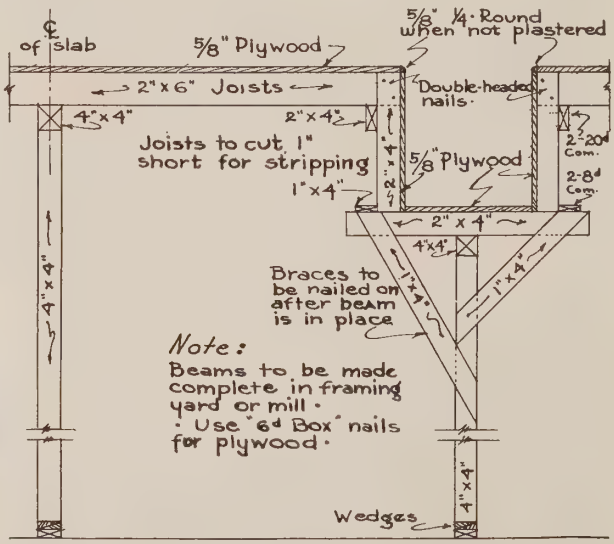
Repeated re-use brings down the unit cost of forms to small figures, with indirect savings on material storage, handling, and overhead.

Building contractors in many larger cities, learning of plywood formwork savings, are utilizing the special panels for residential basement walls, moving the panels, nailed to a simple 2x4 frame, from job to job, and thus showing form costs as low as one (1) cent a square foot for material.

As to suitableness, the concrete form panels of plywood are satin-smooth, and, by virtue of their large dimensions, produce smooth finished concrete, practically devoid of fins and blemishes. The savings in rubbing and finishing a job formed with fir plywood are estimated by experienced and reliable contractors at from seven to fifteen cents per square foot.

Plywood form panels are available in thicknesses of ½", 9/16", ⅝", 11/16" and ¾", to serve as sheathing and lining combined. Largest, and most common of stock panels are 4'x8', probably the most practical size for the majority of concrete jobs.

ARCHITECTURAL beauty attributable in part to the use of Douglas fir plywood forms. Photo shows California Fruit Growers Exchange, Los Angeles.




TYPICAL beam and slab forms of Douglas fir plywood.

Most popular thickness is ⅝", although large volumes of 9/16" and ¾" are used.

All of these panels are unusually rigid and strong, free from splitting, buckling and troublesome warps, and as a consequence, the concrete surfaces are straight and true.

Plywood forms may be procured with a mill-priming or oiling, thereby reducing cost of treatment at job. They should be cleaned and oiled again before each re-use.

Carpentry labor is minimized through the time saved in handling plywood. No cleats are necessary to build up wide panels. Nails are driven easily, within ¼ or ⅜ inch of edges without danger of splitting the sheet. In applying form panels to a frame, the nails used should be as small as practicable, i.e. 5d nails for panels up to ⅝" thick, and 6d for 11/16" and ¾". Double-headed nails should be used wherever possible to facilitate stripping.

For curved walls, arches and the like, and for jobs not large enough for repeated uses, builders often use ¼" plywood in the wallboard grade, as a lining material. It should be applied with 2d nails on a sheathing either

of 5/8" plywood or of solid lumber. This thin plywood will produce the same smoothness in the concrete as do the thicker form panels, but should not be called upon for more than one or two re-uses.

Contractors should distinguish between the grade-marked "Concrete Form Panels" made with special glues and intended for repeated re-use under severe conditions, and stock panels of a Sound 2 Sides grade intended for general interior use.

Some Concrete Form Panels are also edge-coated with special colored sealers to facilitate identification and to give added protection.

* * *

## Plywood Basketball Floor Enters Its Third Year

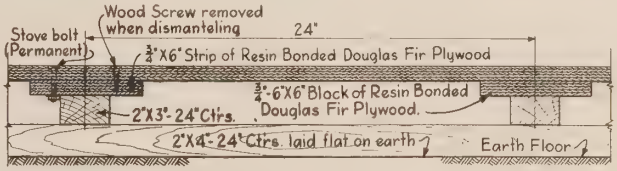
The University of Washington's portable basketball floor of Douglas fir plywood has recently been laid for the third successive season on the Seattle campus. Each panel fitted into its allotted place, accurately and quickly to form a playing surface as smooth and perfect today as it was two years ago.

The use of plywood for a great University's basketball floor is due to the initiative and research work of Professor Charles C. May, Superintendent of Buildings. A previous floor, not plywood, had caused continuous maintenance expense and difficulty. The service conditions were rigorous since the basketball court had to lie each season on the earth floor of the athletic pavilion, other times used for track and field work. Near the surface of the earth floor are a number of steam pipes which cause a constant state of dampness under the floor and since the air above is cool, condensation is heavy. This proved the undoing of the original floor and during the basketball season carpenters were kept busy three days a week repairing sections that had buckled from absorbing moisture.

The solution to these problems has been found in the present floor built of 4 x 8 foot resin-bonded Douglas fir plywood panels.

The accompanying sketch shows the details of the floor construction which consists essentially of 2 x 4 stringers placed on the ground, over which go 2 x 3's, on which the resin-bonded panels are placed and screwed down to plywood strips in such a way as to effect a continuous solid panel.

In regard to the playing qualities of the floor, it is the unanimous opinion of the coaches and players that the plywood floor is superior to the old one in every respect. Ralph Bishop, ex-varsity player and Olympic Champion, states, "The portable plywood basketball floor at the University of Washington is the best floor I have ever played on—this includes the best floors in the United States and a few in Europe. A plywood floor gives resilience combined with durability. Also, a plain surface devoid of adjoining cracks gives the players' shoes better traction. These are the essentials of a good basketball floor."




PORTABLE BASKET BALL FLOOR
Sketch showing how edges of floor panels are held together.

DETAIL of construction of removable basketball floor. Note how the joints are reinforced with ¾-inch 6 x 6 inch block of resin-bonded Douglas fir plywood, bolted to one panel and with wood screws into the next. Steam pipes for heating the area are in the ground immediately under this flooring, making a particularly severe condition for decay, warping, etc. Yet this basketball floor has stood up for several seasons.

THE University of Washington basketball floor of Douglas fir plywood laid on the ground in the Campus field house at Seattle, Wash. In spite of this severe service, these panels have been relaid season after season without apparent depreciation.

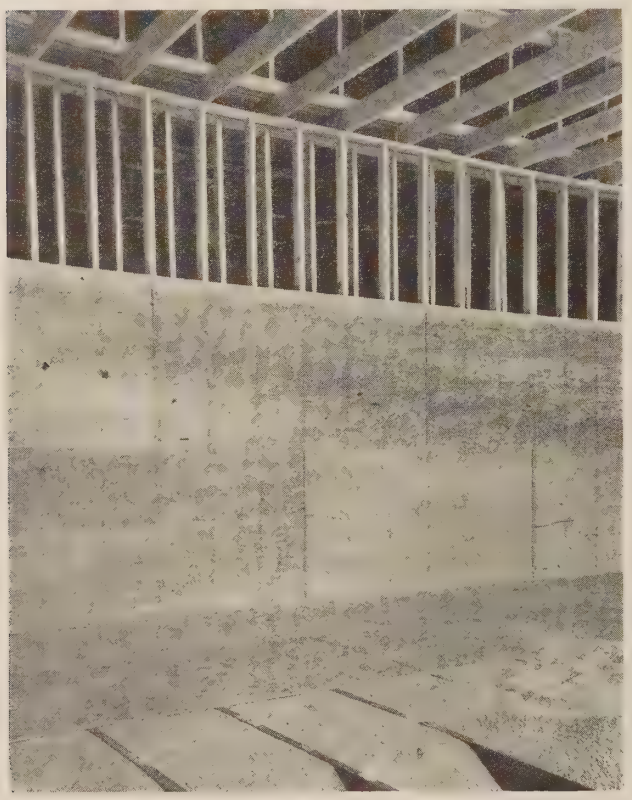
# Plywood for Industrial Buildings, Schools, Etc.

WAREHOUSES, schools, exhibit halls, and recreational buildings are but a few of the structural types in which fir plywood is in demand.

Rigid surface coverings, subflooring, and sheathing are logical uses for plywood in these heavier duty buildings just as in residences. In addition, the ingenuity of the trained architect and the experienced builder often discovers unorthodox functions which plywood can fill with complete satisfaction.

In a large addition to a refrigeration storage plant between Seattle and Tacoma, fir plywood was called upon for several important services. The design involved the use of treated sawdust as insulation in walls and floors. Stock fir plywood sheathing, 5/16-inch thick was used on each surface of the walls and partitions not only as structural sheathing but also as a container for the sawdust. Over the plywood was placed two layers of a vaporproof paper to exclude moisture from walls and thus prevent condensation. Finally, a surfacing of ¼-inch resin-bonded fir plywood was installed on the interior walls and ceilings of all the various cold storage rooms, as well as on the exterior. The builder, Steve Gray of Puyallup, Washington, estimated labor savings of 60 per cent through the use of plywood sheathing.

At the Cleveland Exhibition in 1936-37, the great Hall of Progress was built with rigid timber frames, sheathed with stressed coverings of Douglas fir plywood which was designed to carry a large portion of the load. A nailing schedule carefully worked out by the engineer, C. Merrill Barber, made it possible to utilize ⅝-inch stock panels of fir plywood for such an important structural service, thereby reducing the framing difficulties and costs, and creating an appearance of unusual strength and solidity.



PLYWOOD sheathing, sub-flooring and siding combined with lumber framing and treated sawdust insulation to produce efficient refrigerating warehouse in the Pacific Northwest.

Earthquake hazards in various localities have accentuated the need for designing schools and other public buildings to provide for the horizontal vibrations and stresses due to earth tremors. For such designs fir plywood is a natural, logical material in floors and roofs.

In addition, many localities employ temporary or portable school rooms to provide facilities in new but rapidly expanding residential areas.

Excellent utilization of fir plywood is shown in photographs of a modern double-unit portable school building. For the weather surface, ¼-inch resin-bonded fir plywood is used, with careful attention to flashing of horizontal panel joints. Noteworthy is the thin ¼-inch subflooring, also of resin-glued material. The architect selected this to assure permanency against dampness from below, since no basements are provided, and also as an air-tight and dust-proof membrane.

PORTABLE bunkhouse developed by the U. S. Forest Service for rangers in the Tieton Mountains. Sections consist of Douglas fir plywood walls, floors and roofs with simple trussed rafter construction. Units are bolted together on the job when these portable bunkhouses are assembled.

Even this ¼-inch fir plywood served as a suitable working platform during construction, although it will be covered with a conventional hardwood strip flooring.

Portable buildings and units are in demand for camps, bunk-houses, and cantonments. The obvious advantages of fir plywood are strength and rigidity, light weight, and large panel sizes.

Portable units being built for the Forest Service are illustrated. Roofs, sidewalls, and floors are sheathed with stock plywood, with a heavy building paper covering the roof. Walls are thoroughly painted, with moulding strips for added joint protection. For permanent construction,

THE Great Hall of Progress at the Great Lakes Exposition in Cleveland, 1936-37, was built with rigid timber frames, sheathed with stress coverings of Douglas fir plywood. C. Merrill Barber, engineer.

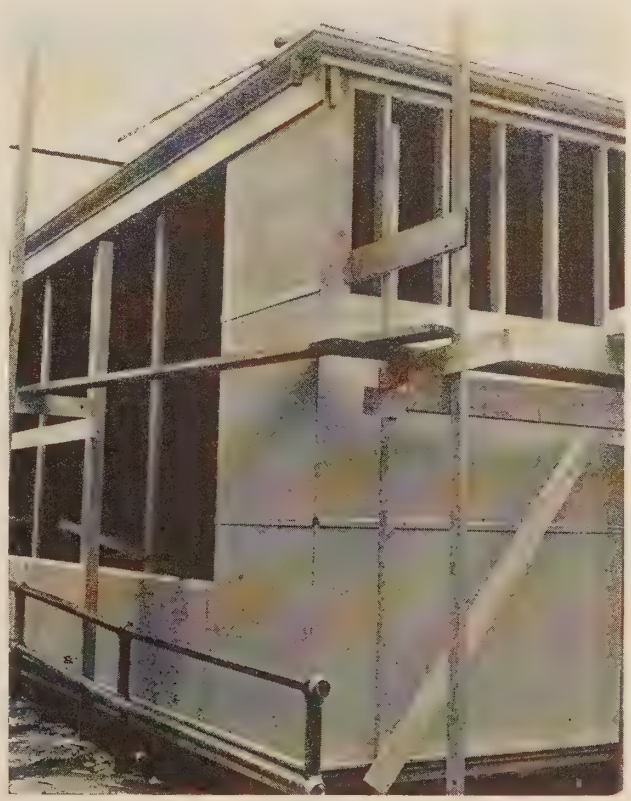
waterproof plywood would be the choice for walls and roof.

Recreational buildings at pleasure resorts such as the world famous Paradise Valley in the shadow of Mount Rainier, offer numerous possibilities for judicious use of fir plywood. Thousands of feet of it have been used by Manager Paul Sceva in making Paradise Inn and other buildings there comfortable and attractive for the visiting thousands. In addition to conventional wall paneling, plywood has been used as a wainscot to protect porous insulating materials; as a temporary ceiling during the zero winters, to isolate the upper portion of the huge lobby; and as a winter dance floor for guests warming up for the next day's skiing. This floor is kept well varnished and waxed and is reported to be in perfect condition as it enters its second season.

Fir plywood thus offers an opportunity for low-cost dance floor installations in the thousands of roadside inns, food emporiums, and what-nots dotting the highways of America.

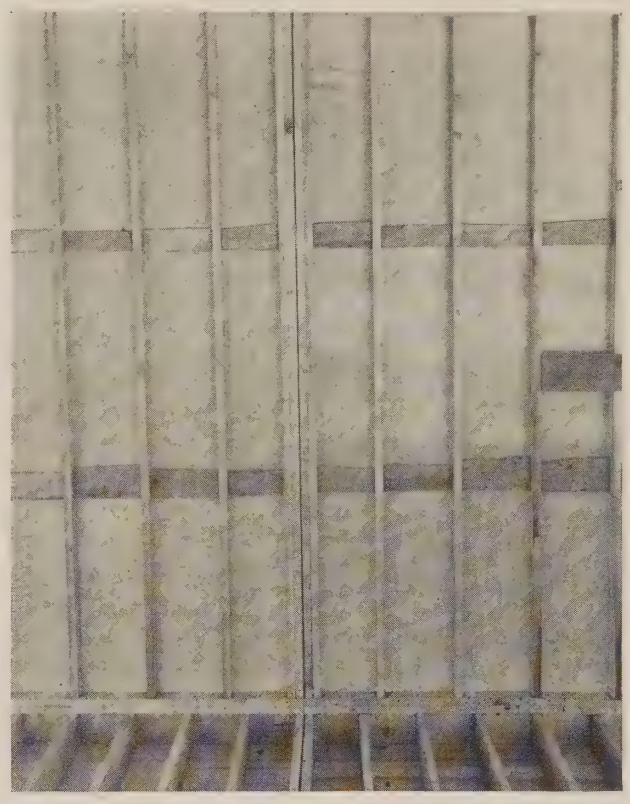
Tourist cabins, which in many sections of the country approach home comfort in their appointments, are using fir plywood.

When the Boy Scouts come to town for their annual jamboree, or when a great festival, convention, or fair



A portable school with exterior surface of resin-bonded Douglas fir plywood. Horizontal joints between sheets is combination of wood moulding and sheet metal flashing.

INTERIOR corner showing 1/4-inch resin-bonded plywood on walls and floors. Note one-inch material fitted between studs as backing at horizontal joint lines.



VERTICAL joints between two units permitting either to be moved to new site. Plywood walls and sub-flooring add necessary rigidity for all portable structures.

draws near to tax the facilities of a city, the opportunities appear obvious for an enterprising civic body to meet such emergency peak loads through the speedy erection of plywood cabins, barracks, mess-halls, and auxiliary buildings. Floods and other calamities may create similar housing emergencies.

We venture an editorial augury that in case the present international policy of ruthless conquest embroils the U. S. in its wake, the U. S. War Department, always alert to modernization, will produce from its files detailed plans for cantonment buildings in which Douglas fir plywood is the principal covering material.

Ruggedness and wide adaptability fit it for the role of the "multi-purpose material."

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# Farm Uses of Plywood

By HENRY GIESE

Professor of Agricultural Engineering, Iowa State College

THE great need at the present time in farm construction is a better conception of the use requirements or functions of the buildings and a more scientific use of materials in accomplishing the desired results.

A survey of existing farm buildings shows a number of weaknesses in the basic construction. A few of these are:

*Bracing.* Many buildings are short-lived and expensive on an annual cost basis because of failure to provide diagonal braces. The conventional construction using vertical and horizontal members only, easily settles out of shape when subjected to wind loads or to pressures exerted by stored farm crops.

*Anchoring.* Insecure anchoring to the foundation permits overturning or sliding off the foundation in windstorms.

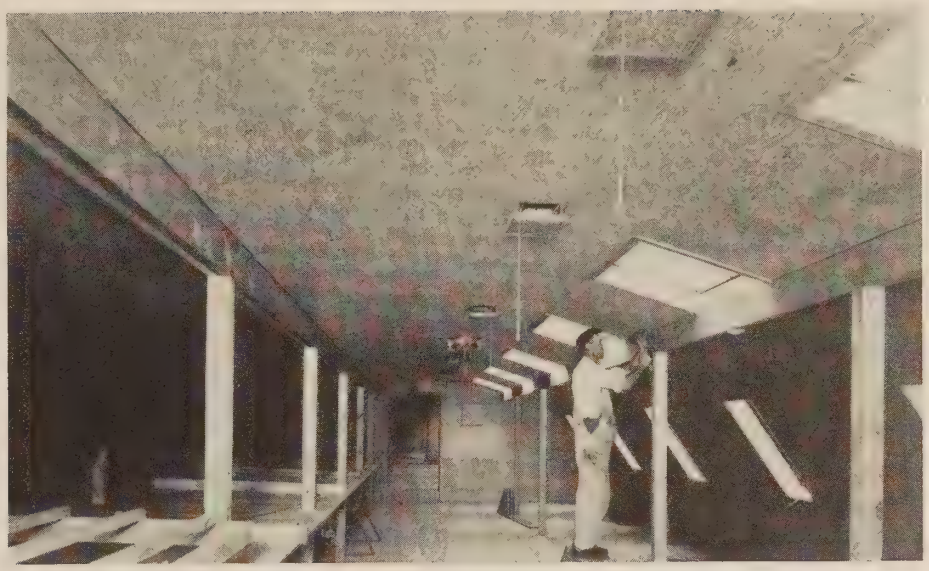
*Splitting.* Ends of sheathing boards spliced over studs, joists or rafters are frequently split by the nails.

*Air infiltration.* Much is now being said of ventilating and insulating animal shelters. Neither can be controlled if walls and ceilings are full of cracks permitting almost unlimited air infiltration during high winds.

*Weight.* The increase in the use of movable structures makes excessive weight and clumsiness in handling a problem.

Because of its inherent strength properties, its availability in large sheets, its relative freedom from splitting, and its ability to overcome the difficulties mentioned above, plywood may find successful application in all of the buildings commonly found on the farm and including houses, barns, cribs, grain bins, hog houses, poultry houses, brooder houses, cattle and sheep sheds, fruit and vegetable storages, farm shops, garages, machinery sheds, self feeders, etc.

A few of the specific uses are roof and side-wall sheath-



**BOTH interior and exterior of this large poultry house are covered with Douglas fir plywood panels which speed construction and provide a weather-tight structure.**

ing, flooring, doors, walls, ceiling, bin lining, feed boxes, ventilating flues and many others.

Its greatest contribution will doubtless be where the service rendered gives promise of offering material improvement in performance over present construction methods. The poultry brooder house and the individual hog house are good examples.

A brooder house, almost a farm necessity, should be comfortable, economical, and convenient. To be comfortable, it should be warm and dry, properly lighted and ventilated, and of adequate size; one that can be successfully heated with one brooder stove and yet give the chicks sufficient room. To be economical, it should be relatively low in first cost and yet be strongly built and durable to give long life free from expensive upkeep. To be convenient a movable brooder house must be capable of being cleaned easily, properly proportioned and readily moved.

First of all a brooder house must be movable. Designed to house chicks on clean ground away from disease, it fails to serve its intended purpose, if for any reason, the farmer does not move it. Most of the brooder houses now built weigh from 2,000 to 3,000 pounds and are so heavy that they can be moved only with difficulty.

If the heavy, clumsy structure is moved frequently over rough ground, joints are loosened and short productive life results. By using large panels of relatively thin plywood, the weight can be reduced by more than one-half. In addition to using thinner materials, the size of supporting members can also be reduced. Plywood construction reduces the number of cracks and helps to control infiltration. By adapting the plywood to curved roof construction, the necessary head room can be provided for the operator with a material reduction in the exposed area and the space to be heated.

**POULTRY brooder house using laminated bent rafters and plywood panels weigh less and are stronger than when built of natural lumber.**

## Possible Uses for Plywood

**(The summary of a study of Midwest Plans)**

**Probable Adaptability**

| Average Building | Adapted | | May be Adapted | |
|---|---|---|---|---|
| | Quantity sq. ft. | % Total bd. ft. | Quantity sq. ft. | % Total bd. ft. |
| Ho ıse | 1,200 | 11 | 17,050 | 45½ |
| Barn | 850 | 3½ | 15,100 | 60 |
| Cattle and sheep shed | ..... | .... | 3,130 | 45 |
| Hog house | ..... | .... | 1,700 | 30 |
| Brooder house | ..... | .... | 1,365 | 65 |
| Poultry house | 550 | 2 | 3,980 | 80 |
| Hay shed | ..... | .... | 4,900 | 53 |
| Grain storage | 500 | 4½ | 2,600 | 25 |
| Fruit and vegetable storage | 900 | 22½ | 1,460 | 40 |
| Garage | 800 | 36 | 1,100 | 50 |
| Machine shed and shops | 200 | 4½ | 3,300 | 44 |
| Ice house | 150 | 3 | 3,350 | 84 |
| Milk house | 160 | 15 | 500 | 50 |
| Creamery | 500 | 4 | 4,525 | 37½ |
| Concrete stock tank | 130 | 65 | ..... | .... |
| Livestock self feeder | 8 | 1½ | 240 | 50 |
| Poultry self feeder | ..... | .... | 11 | 58 |
| Septic tank | 106 | 37 | 45 | 16 |
| Filters and cisterns | 60 | 25 | 34 | 14 |
| Average | ..... | 11¾ | ..... | 42¼ |

## Tool Cabinet of Plywood

A neat tool cabinet of unusual capacity for its size and of exceptionally rigid construction is presented in the accompanying illustrations.

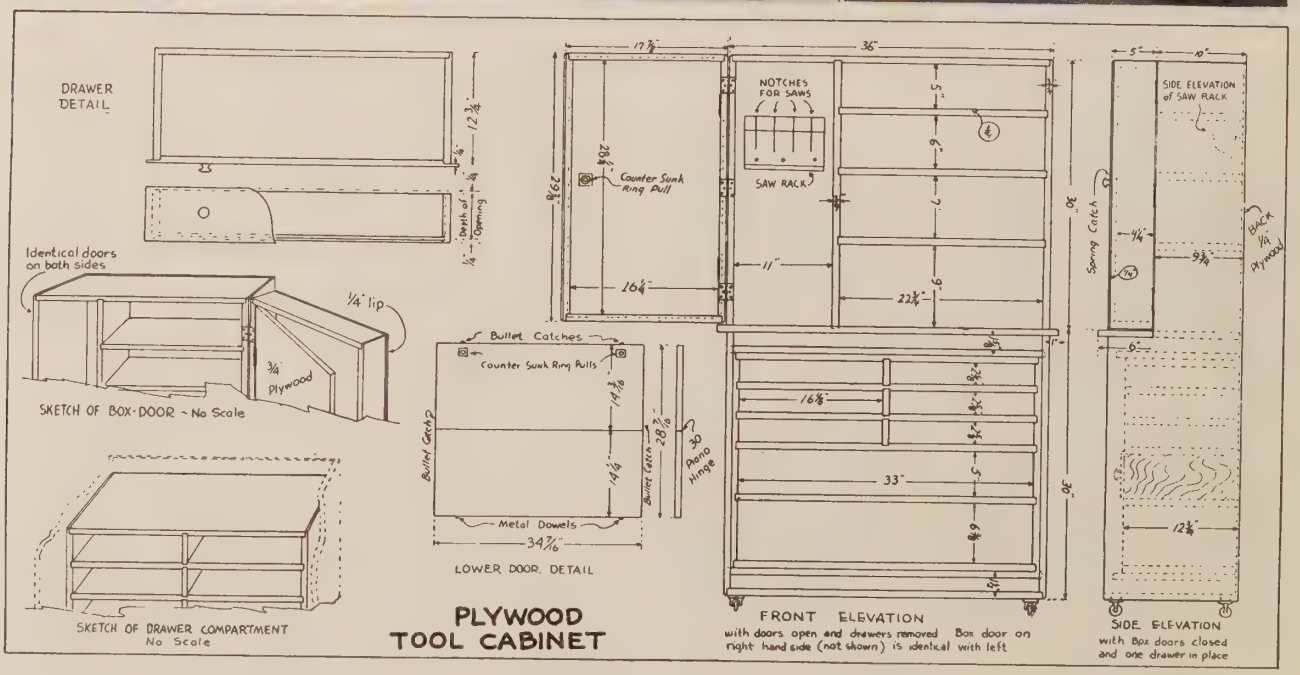
As shown in figure 1 the front panel of each of the two box-door tool compartments is made of ¾-inch plywood, dadoed ½-inch all around to lap over the sides. Both of these panels should project 3/32-inch toward the center of the door. This lip eliminates the gap which would otherwise be present when the doors are closed. Be sure to use ¾-inch plywood rather than ¼-inch for the front panels and the hinged panels of the box-doors to provide a sufficiently thick panel on which to mount tools.

The top compartment in the bottom section is especially handy for miter-box saw which is usually too long to find convenient room elsewhere.

The drawer compartment is built separately, and slipped into place after the body of the cabinet is ready. Check the inside dimensions of the section into which it goes to be sure clearance is allowed so it will slip into place. This method of making drawer compartments of plywood is much simpler and stronger than the conventional mortise and tenon method.

Drawer opening partitions are made of plywood.

The cabinet may be finished in any number of decorative treatments. A simple and inexpensive finish is stain, of color choice, and wax, or the plywood left natural with shellac and varnish applied.




KANE & HARCUS CO., EVERETT, WASH. 59525

# Resinous Bonded Hot Plate Plywood for Outdoor Uses

THE importance which plywood has attained as a building material is evidenced by the five-fold increase of the productive capacity of the industry in just a few years. That this industrial growth has been possible with practically no systematic research or co-ordinated trade promotion indicates the essential merit of the product.

Once the building trades and the various re-manufacturing industries discovered the advantages of laminated wood panels in various types of construction, it was only natural that a product which performed so satisfactorily in so many places should be offered and accepted for use for purposes beyond its ability to perform. The need for a fir plywood which would have positive and guaranteed resistance to all moisture exposure prompted laboratory research by progressive manufacturers. Resinous bonded hot plate fir plywood was developed, proved by actual usage, and finally marketed under a guarantee that the plies would not separate under any moisture conditions including live steam or boiling water, or under actual weather conditions.

This opened up a field previously closed to ordinary plywood, for, in addition to producing an absolutely waterproof plywood, the binder was found to be proof against attacks of termites and fungi. The same economies which have made fir plywood so acceptable for interior purposes were now available for exterior uses.

Faced with rapidly rising construction costs, numerous research agencies in their efforts to provide low cost housing found this new weatherproof product ideal.

Houses with plywood exteriors, some with plywood roofs, entirely prefabricated, semi-prefabricated or built on the job, ranging from small summer cabins to palatial residences have appeared in all sections of the country during this past year. This outside use has been made possible by resinous bonded hot plate plywood.

NEW type portable cottage developed at Jacksonville, Fla., built almost entirely of outdoor plywood. Many other types of plywood cabins are gaining popularity.

The modernistic effect that previously was confined to interiors can now be obtained for exteriors by bending the plywood into graceful curves. This has proven a boon to architects in both remodernization and new construction. One application of this has been in the modernization of dealer's offices and yards.

While waterproof plywood is vitally necessary to the building trade, it is likewise indispensable to the manufacturer who offers a product which must stand up under extreme moisture conditions. This new material has been readily accepted by the large car manufacturers who furnish the buses for nation-wide travel. It has made their buses lighter, stronger and more comfortable.

MODEL home in California. Outside walls of outdoor plywood; joints covered with aluminum batten strips. With waterproof joints architects are finding many new designs entirely practical.

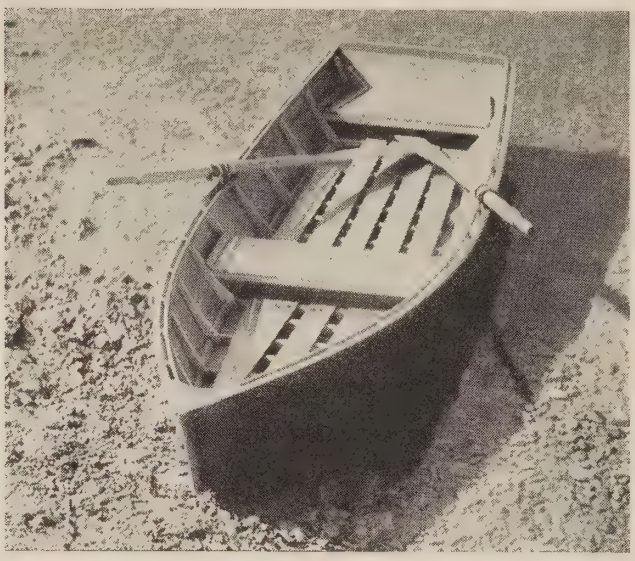
OUTDOOR plywood gives strength and durability to the trailer models of this and other manufacturers.

The better class trailer manufacturers also use it in their construction. Its lightness, flexibility and strength, combined with its resistance to weather, makes waterproof plywood ideal material for this purpose.

Only a little over a year ago, the first announcements were made about hot plate resinous bonded fir plywood. Naturally, with the cooperation that has been extended by the editors of *American Builder* and other magazines, there have been numerous requests to the manufacturer for additional information about the product. One request has been most interesting. It would seem that almost everyone has a special lake or river that he is just bound to explore. No matter what other information they want, a great majority of the inquirers wish to know whether it can be used to build a boat. The answer is that it is used not only for small rowboats but for good-sized cruisers and several collapsible types are now being offered—all with guaranteed waterproof plywood.

There are many new uses developing every day—for instance, pallets upon which to cure concrete blocks or "soft mud" bricks. Contractors tried steel, glass, hardwoods, but they all lacked something. But the resin bonded plywood filled the bill.

For concrete form material, there is great economy when the job is a multiple one, where the same form can be used a large number of times. With resin bonded plywood concrete forms will still be serviceable after 30 to 50 re-uses.



INTO boats all over the United States go carloads of outdoor plywood.

All signs point to a rapidly expanding market for this new product. Outdoor signs are beginning to lead the way. Here's an outlet which may eventually take all that can be manufactured. The outdoor sign is a natural for hot plate resin bonded plywood—stronger than any other material pound for pound, corrosion proof, fungus proof, termit proof, waterproof, takes paint better, will not chip off, can be worked into any shape desired. The progressive sign people will soon be using guaranteed weatherproof plywood for a wide variety of purposes.

And so—hot plate resin bonded plywood carries on—out in the open—impervious to weather conditions—accomplishing new economies in building and manufacturing—creating new products—carries on from the point where ordinary plywood leaves off.

ANOTHER "natural" use for outdoor plywood—all signs exposed to the weather.

# GRADE USE GUIDE

## Douglas Fir Plywood, Manufactured and Graded Under Rules and Supervision of Douglas Fir Plywood Association, Tacoma

### Inspection

The manufacture and grading of Douglas fir plywood is supervised by the inspection department of the Douglas Fir Plywood Association. This insures a uniform high standard of Douglas fir plywood from all manufacturers who are members of the association.

As the plywood comes from the mill, each piece is rigidly inspected by expert graders and placed in its proper quality class. The work of these graders in association mills is checked currently by official association inspectors, to assure that each mill grades its plywood uniformly in accordance with published association rules (U. S. Department of Commerce, Commercial Standard CS45-36). Their chief duty is to see that a high standard of grading and inspection is maintained. The inspectors furnish daily reports to the mill superintendent and to the association, on manufacture and workmanship as they affect grades.

An official inspection certificate which certifies that the plywood from the association mill has been inspected and found to comply with the grade specifications of the association grading rules (U. S. Department of Commerce, Commercial Standard CS45-36) is furnished where requested and can be obtained by buyers so specifying from any manufacturer who is a member mill of the Douglas Fir Plywood Association.

## Recommended Grades of Douglas Fir Plywood

### Grade Names Refer to Standard Grading Rules of Douglas Fir Plywood Association and to U.S. Commercial Standards, CS45-36

### 1. Buildings, Light Framed or Light Joisted Construction, Rough Carpentry

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| **Walls and Partitions** | | |
| Sheathing | Sheathing or | 5/8″, 3/8″, 5/16″ |
| | WB (unsanded) | 9/16″, 7/16″ |
| **Floors and Roofs** | | |
| Subflooring | Sheathing or | 5/8″ |
| | WB (unsanded) | 9/16″, 7/16″ |
| Roof Sheathing | Sheathing or | 5/8″, 5/16″ |
| | WB (unsanded) | 9/16″, 7/16″ |
| Roof Decking, Flat Covered | Sheathing | 5/8″ |
| | WB (unsanded) | 9/16″ |
| | SO2S (unsanded) | 3/4″ or more |
| Cellar and Attic, Treads and Risers | WB or | 9/16″ |
| | SO2S | 5/8″ |

### 2. Buildings, Heavy Framed, Heavy Joisted, or Heavy Timbered Mill Construction, Rough Carpentry

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| Plank Decking, Floors and Roofs, Tongued and Grooved, or Splined | SO2S (milled as desired) | 5/8″ and thicker |
| Subflooring | SO2S | 5/8″ and thicker |
| Partitions (tongued and grooved or splined) | SO2S (milled as desired) | 5/8″ and thicker |
| Partitions (stud framed) | (For lining, see I) | |
| Stair Treads and Risers | SO2S | 5/8″ and thicker |
| Heavy Shelving | SO2S | 5/8″ and thicker |
| Roof Trusses | | |
| Gusset Plates | Special Mill Order | |

### 3. Buildings, Framed, Joisted, or Heavy Timbered Mill Construction, Exterior Finished Carpentry and Millwork

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| Ceiling (porch) | Special Concrete Form Stock | 1/4″, 3/8″ |
| Exterior Wall Panels | G1S (resin-bonded) | 3/8″ and thicker |

### 4. Buildings, Fireproofed Construction, Rough and Exterior Carpentry

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| Subflooring | Sheathing | 5/8″ |
| | SO2S | 5/8″ and thicker |
| Roof Decking, Flat Covered | WB or | 1/2″ |
| | SO2S or | 1/2″ and thicker |
| | Sheathing | 5/8″ |

### 5. Buildings, Framed, Joisted, Heavy Timbered Mill, or Fireproofed Construction, Interior Finished Carpentry, Millwork and Cabinet Work

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| **Finished or Top Flooring** | | |
| Attics, Closets, Storerooms | WB or | 1/2″ (or 9/16″ unsanded) |
| | SO2S | 9/16″ and thicker |
| Covered Floors | Sheathing | 5/8″ |
| | WB or | 1/2″ (or 9/16″ unsanded) |
| | SO2S | 9/16″ and thicker |
| **Finish and Trim** | | |
| Attic Stair Treads or Stepping and Risers | WB or | 1/2″ |
| | SO2S | 9/16″ and thicker |
| Wall or Ceiling Surfaces or Paneling | WB | 1/4″, 3/8″, 1/2″ |
| | G1S | 1/4″ and thicker |
| Ceiling, Partition, and Closet Lining | WB | 1/4″, 3/8″, 1/2″ |
| | G1S | 1/4″ and thicker |
| V-jointed or Other Milling If Both Sides Exposed | As Ordered | |
| | SO2S or | 1/4″ and thicker |
| | G2S | 1/4″ and thicker |
| Ceiling, Beams, Built Up | WB or | 1/4″ |
| | G1S | 1/4″ |
| Shelving, Light | WB or | 3/8″, 1/2″ |
| | G1S | 3/8″ and thicker |
| Shelving, Store | SO2S | 1/2″ and thicker |
| Counter Tops | G1S | As desired |

### 13. Stadiums, Grandstands and Bleachers

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| Roof Decking | Sheathing | 5/8″ |
| | WB | 1/2″ (or 9/16″ unsanded) |
| Seats and Seat Backs (under roof) | Concrete Form Panels (specially cut to size) | As desired |
| Wall Covering (interior) | WB or | 1/4″, 3/8″ |
| | SO2S | 1/4″ and thicker |

### 17. Towers and Derricks

| USE-ITEM | GRADES RECOMMENDED |
|---|---|
| Gusset Plates | Special Mill Order |

### 19. Billboards and Signs

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| Panels | WB (resin-bonded) | As desired |
| | or | |
| | G1S (resin-bonded) | As desired |

### 21. Concrete Forms

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| Boarding and Panels | Concrete Form Panels | 1/2″, 9/16″, 5/8″, 11/16″, 3/4″ |
| Form Lining (one use) | WB | 1/4″ |
| Form Lining (reuse) | SO2S Made with Concrete Form Glue | 1/4″ |

### 26. Sidewalk Protection

| USE-ITEM | GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|---|
| One Use | Sheathing | 5/8″ |
| For Reuses | Concrete Form Panels | 5/8″, 11/16″, 3/4″ |

### 27. Studio, Stagecraft, Convention Booths, Cutout Displays

| GRADES RECOMMENDED |
|---|
| WB or as desired |

### 28. Temporary Fronts

| GRADES RECOMMENDED | THICKNESS Commonly Used |
|---|---|
| WB or | 1/4″ and thicker |
| SO2S | 1/4″ and thicker |

# Glossary of Terms and Abbreviations

In design, on plans and in purchase specifications, it is convenient to use abbreviations. Terms and abbreviations for Douglas fir plywood are at times somewhat different from those used in lumber and accordingly are presented below:

**Abbreviations**

| | |
|---|---|
| G2S | Good 2 Sides |
| G1S | Good 1 Side |
| SO2S | Sound 2 Sides |
| WB | Wallboard |
| No. 1DP | No. 1 Door Panel |
| No. 2DP | No. 2 Door Panel |
| S2S | Sanded 2 Sides |

**Glossary of Terms**

**Centers**—See Cores.

**Checks**—Small splits running parallel to the grain of the wood caused chiefly by strains produced in seasoning.

**Cores**—A core or center is the innermost layer in plywood construction.

**Crossbanding**—Veneer used in the construction of plywood with five or more plies. In 5-ply construction it is placed at right angles between the core and faces.

**Defects, open**—Checks, splits, open joints, cracks, loose knots, and other defects interrupting the smooth continuity of the panel surface.

**Heartwood**—Sometimes referred to as "heart"—the darker-colored wood occurring in the inner portion of the tree.

**Knots**—Cross section of a branch or limb whose grain usually runs at right angles to that of the piece in which it is found.

**Knot holes**—Voids produced by the dropping of knots from the wood in which they were originally embedded.

**Lap**—A condition where the veneers used are so misplaced that one piece overlaps the other rather than making a smooth butt joint.

**Patches**—Insertions of sound wood glued and placed into panels from which defective portions have been removed.

**Pitch-pockets**—Well-defined openings between rings of annual growth, usually containing, or which have contained, more or less pitch, either solid or liquid.

**Pitch streaks**—A streak is a well-defined accumulation of pitch in a more or less regular streak.

**Sapwood**—Sometimes referred to as "sap"—the lighter colored wood occurring in the outer portion of the tree.

**Shim**—A long, narrow patch not more than $\frac{3}{16}$ inch wide.

**Streaks**—See Pitch streaks.

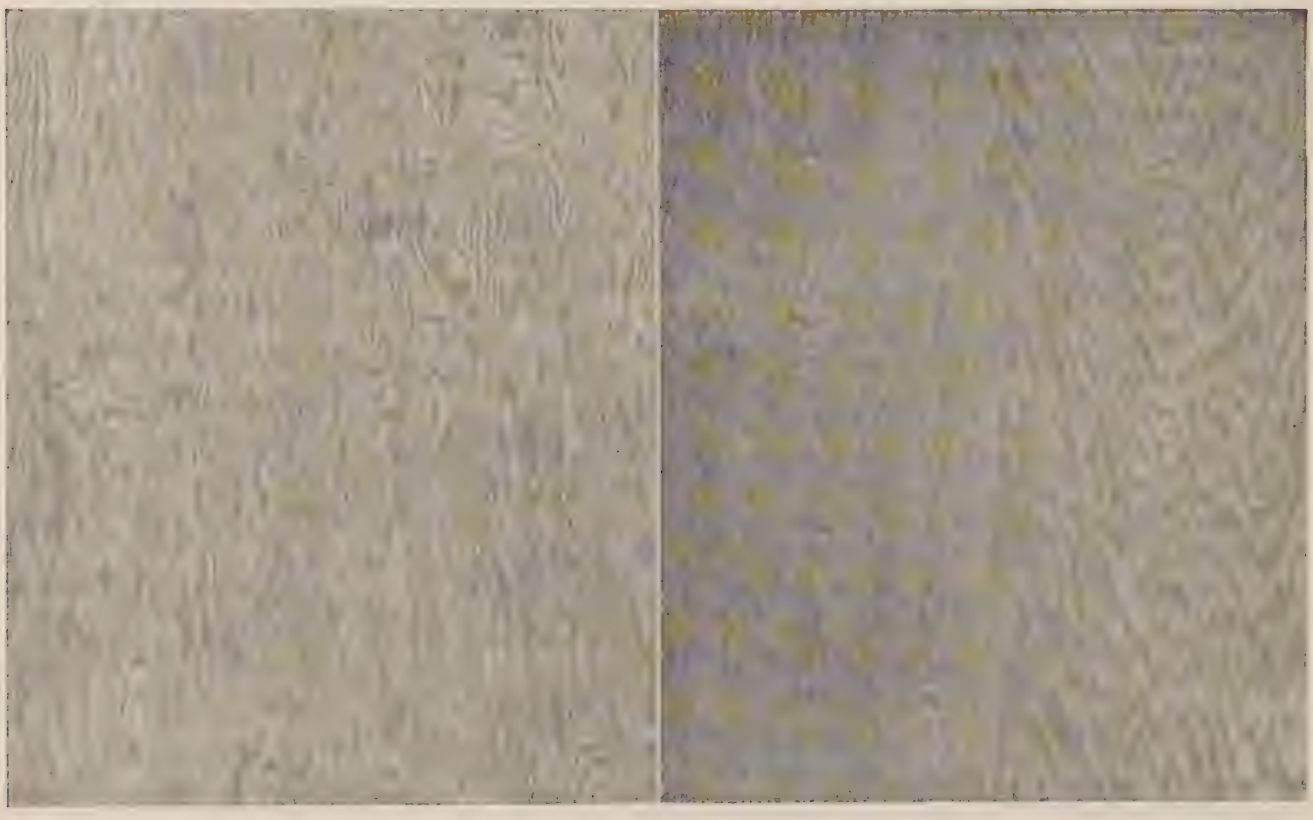


FIG. 1 FIG. 2

*Figure 1 shows a typical face in a Good 1 Side panel; figure 2 shows a Sound "back." This particular one consists of two narrow pieces glued side by side; only the variation in grain reveals the perfectly fitted joint. It is intended that above illustrations be representative of the grade, but not necessarily to establish limits.*

| GRADE | DESCRIPTION | USES |
|---|---|---|
| G1S | One face is as good as the faces in a G2S grade, while the opposite face or back is a "Sound" face, as described under the next grade. | Also suitable for highest quality of wall paneling, ceiling, partition or other surface where only one face is exposed, or where the back is only occasionally exposed. Light or dark stains, lacquers, waxes, etc., offer a variety of finishes. |

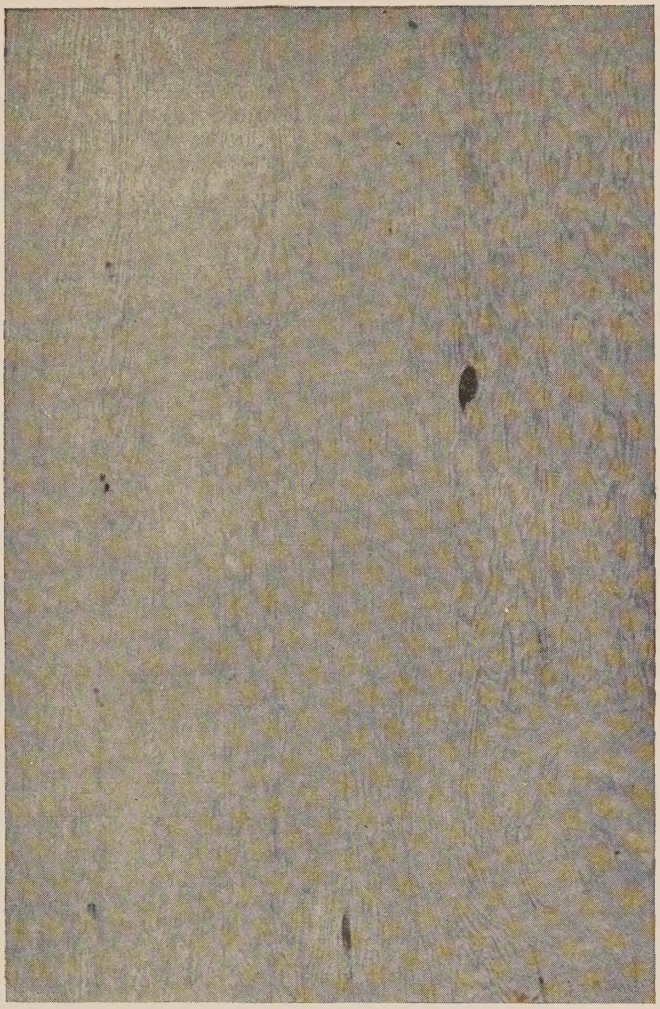


FIG. 3

*Figure 3 shows the reverse side or "back," of a typical Wallboard grade of panel which has sufficient knots, etc., to prevent economical patching. It is intended that above illustration be representative of the grade, but not necessarily to establish limits.*

| GRADE | DESCRIPTION | USES |
|---|---|---|
| **Wallboard** | Really a SOUND 1 SIDE panel. One face is equal to the face of an S02S panel, while the back contains sufficient defects, such as knots, splits, pitch pockets, etc., as to render it unfit for patching. | Probably the most popular plywood grade, where only one face is to be exposed. Suitable for walls, ceilings, partitions or other surfaces that are either to be painted, or papered, or to have a natural or stained finish in which minor blemishes will not be of serious consequence. |

| GRADE | DESCRIPTION | USES |
|---|---|---|
| **Concrete Form Panels** | Panels manufactured with special highly water-resistant glues, and designed to give numerous reuses and smooth unblemished surfaces. | For Concrete Forms and where water-resistant service is desired. |

TABLE OF SIZES AND THICKNESSES OF STOCK PANELS

| ITEM | WIDTHS | LENGTHS | THICKNESSES |
|---|---|---|---|
| Standard Panels | From 12", increasing by 2-in. units to 30"; also 36", 42", and 48" | 48", 60", 72", 84", and 96" | 3/16" (3-ply sanded 2 sides) increasing by 1/16" thicknesses to 1-3/16" (7-ply) |
| Wallboard | 30", 32", 36", and 48" | 60", 72", 84", and 96" | 3/16" unsanded; ¼", ⅜" 3-ply sanded 2 sides; and ½" 5-ply sanded 2 sides |
| Sheathing | 48" | 60", 72", 84", and 96" | 5/16" and ⅜" 3-ply unsanded and ⅝" 5-ply unsanded |

(Larger or odd size panels may be secured on special order)

**Concrete Form Plywood**—Concrete form plywood shall be built up of three or five thicknesses of veneer, of which the two outside plies are at least ⅛ inch thick before sanding. An occasional knot hole is permissible in the center or core of 5-ply panels only but no knot holes are permitted in cross banding.

Faces shall be free from knots or open defects. The glue used shall be especially prepared for this purpose and be very highly water resistant. All concrete form plywood shall be so designated by grade-marking each panel. (When so ordered, concrete form plywood will be treated with a satisfactory form oil or other preparation.) (CS45-36)

## Sizes and Thickness of Douglas Fir Plywood

Douglas fir plywood comes in stock panels up to four feet in width and eight feet in length, but larger panels may be obtained upon special order.

In thickness, fir plywood is manufactured from 3/16" (which may be sanded to ⅛") up to 1 3/16" in increments of 1/16". Greater thicknesses as required may be obtained for gusset plates and other special uses.

There is a suitable grade and an economical thickness of Douglas fir plywood for almost any use.

By gluing together the veneer so that alternate sheets have their grain running at right angles, the manufacturer of Douglas fir plywood capitalizes on the strength of wood along the grain.

Along the grain, wood has a tensile strength and stiffness many times greater than it has across the grain. Furthermore, wood has practically no expansion or contraction along the grain.

Consequently, through alternating the grain direction of the veneer sheets, fir plywood acquires longitudinal grain both lengthwise and crosswise and with it great strength and stiffness in all directions. At the same time, the stability of each sheet along the grain, plus the assured glue bond, prevents the adjacent sheets from shrinking or expanding when subjected to heat or dampness, resulting in plywood panels practically immune against expansion or shrinkage.

All stock panels of Douglas fir plywood are manufactured with water-resistant glue.

Concrete Form Panels are made with special water-resistant glues to assure numerous reuses under severe moisture conditions.

Supplementing such plywood products is the strictly waterproof Douglas fir plywood, manufactured with synthetic resin glues and hot pressed.

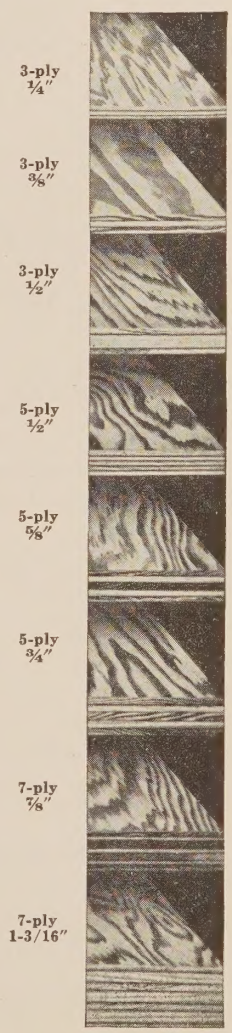



FIG. 4—*Representative plies and thicknesses*

# Structural Data

### Bending and Deflection

Douglas fir plywood is made from thin sheets or plies of Douglas fir wood, laid alternately at right angles to one another, and bonded together with glues that are stronger than the wood itself. Consequently, for those plies having their grain parallel to the span, the same modulus of elasticity as for Douglas fir lumber is used, e. g.,

E = 1,600,000 lbs./sq. in—Numerous tests substantiate this value.

With this value, the deflection of a panel or piece of Douglas fir plywood may be computed readily from the standard deflection formulae.

I, the moment of inertia of the cross-section, however, is computed by considering only those plies that have their grain direction parallel to the span.

In a 5-ply, ⅝" panel, for example, assuming it consists of plies shown in figure 12, ignore the two cross-bands, c and c, and hence,

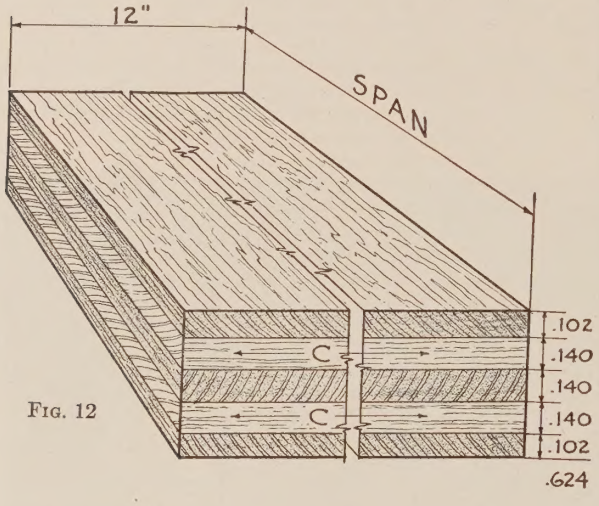



FIG. 12

$$I \text{ (for 12" width)} = \frac{12}{12}\left[\frac{5^3}{8} - (3\times 0.14)^3 + 0.14^3\right]$$

or, $I = .173$ in.$^4$

If the grain of the face plies runs at right angles to the span then only the cross-bands, "c", would be considered in computing the

$$I = \frac{12}{12}\left[(3\times 0.14)^3 - 0.14^3\right] = 26\times 0.14^3 = .071 \text{ in.}^4$$

Below is a table of moments of inertia for various thicknesses of plywood. There are minor differences in the thickness of fir plywood veneers used by the various manufacturers, but the values in the table are based on the minimum assemblies and hence are conservative.

**TABLE I**

**(Grain of face plies parallel to span)**

| Thickness | I (for 12" width) | S |
|---|---|---|
| 5/16"—(3 equal plies) | .029 | .186 |
| 3/8" —(3 plies @ ⅛") | .051 | .270 |
| 1/2" —(3 ply) | .090 | .360 |
| 5/8" —(5 ply 1/11", ⅛", 3/16", ⅛", 1/11") | .167 | .535 |
| 3/4" —(5 ply) | .250 | .667 |
| 1" —(7 plies @ 1/7") | .713 | 1.426 |

Based on numerous flexural tests at the University of Washington Forest Products Laboratory, on samples taken at random from practically all the fir plywood mills, the following range of values was obtained:

Modulus of rupture: 8,500 to 15,200 lbs./sq. in.

Fibre Stress at Proportional Limit—6,900 to 9,800 lbs./sq. in.

### Tension and Compression

In order to present a general comparative picture as to the strength properties of Douglas Fir Plywood, and other materials sometimes used in its place, the results of a series of tests conducted at the Northwest Testing Laboratory, the Northwest representative of the nationally-known Pittsburgh Testing Laboratory, are summarized below:

In the tension tests, all speciments were 3" x 18"; in the compression tests, 6" x 6" pieces were used. Tests on each material were conducted under exactly the same conditions.

| Thickness of material | Tension | | Compression | |
|---|---|---|---|---|
| | Ultimate load | Ultimate stress | Ultimate load | Ultimate stress |
| **LOAD ACTING WITH THE GRAIN OF FACE PLIES** | | | | |
| 1/4", 3-ply | 5250 | 6484 | 4198 | 2855 |
| 3/8", 3-ply | 5644 | 4750 | 6630 | 2860 |
| 1/2", 5-ply | 8024 | 5135 | 10492 | 3497 |
| 5/8", 5-ply | 8132 | 4350 | 10644 | 2893 |
| 3/4", 5-ply | 8912 | 4074 | 18538 | 4186 |
| **LOAD ACTING ACROSS GRAIN OF FACE PLIES** | | | | |
| 1/4" | 2552 | 3291 | 908 | 609 |
| 3/8" | 4684 | 4141 | 5206 | 2180 |
| 1/2" | 7664 | 5108 | 6462 | 2162 |
| 5/8" | 8326 | 4491 | 9096 | 2472 |
| 3/4" | 8796 | 3932 | 15262 | 3436 |
| **TESTS ON OTHER MATERIALS** | | | | |
| A-3/16" | 1248 | 2189 | 390 | 346 |
| B-3/16" | 1276 | 2180 | 846 | 751 |
| C-1/4" | 264 | 352 | 826 | 550 |
| D-7/16" | 152 | 126 | 448 | 170 |
| E-1/2" | 370 | 248 | 690 | 230 |

Key: Material A, old-style fibre wallboard; B, hard, compressed board; C, plaster-board; D and E, insulating boards.

### Sheathing

Tests conducted at the United States Forest Products Laboratory, Madison, Wisconsin, have established that thin Douglas fir plywood is suitable for use as sheathing. The tests on 9′ by 14′ wall panels indicated that ¼" plywood SHEATHING well nailed to a stud frame was more than adequate in both rigidity and strength. The same kind of plywood glued to a similar stud frame proved to have markedly superior rigidity and strength properties.

### 5/16" Plywood Suitable as a Shingle Base

Tests completed in the spring of 1937 at the University of Washington's Forest Products Laboratory, under the supervision of Professor Bror L. Grondal, recognized shingle authority, showed that it required a force of 85 pounds (minimum) up to 125 pounds to pull an 8-inch red cedar shingle (one of a panel of shingles applied in accordance with standard practice) from 5/16" fir plywood.

This force is equivalent to a wind pressure of nearly 300 pounds per square foot, a force greater than that of a hurricane. The reason for 5/16" Douglas fir plywood's suitableness as a shingle base is that plywood holds the shingle nails with a greater force than that required to pull the nail heads through the shingles.

Professor Grondal, Special Consultant for the Red Cedar Shingle Bureau, and co-author of their Official Handbook, has approved 5/16" Douglas fir plywood as a base for shingles.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